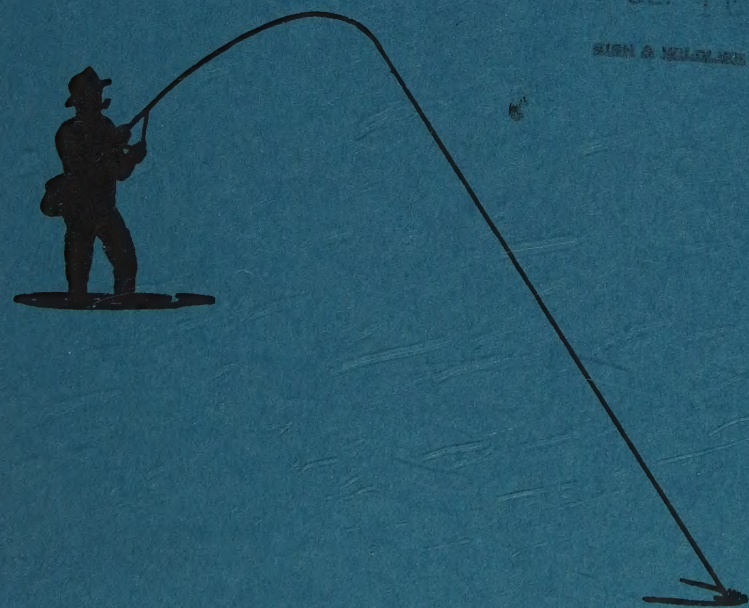
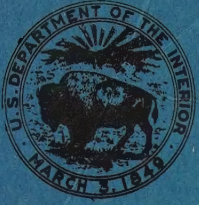


Sport Fishery Abstracts



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Water Pollution Abstracts

A. K. Winner

7436. Nomura, Minoru (Tokyo Univ. Fish., Minato-ku, Tokyo). 1964. STUDIES ON REPRODUCTION OF RAINBOW TROUT, *SALMO GAIARDNERI*, WITH SPECIAL REFERENCE TO EGG TAKING. VI. THE ACTIVITIES OF SPERMATOOZOA IN DIFFERENT DILUENTS, AND PRESERVATION OF SEMEN. Bull. of the Japanese Society of Scientific Fisheries, Vol. 30, No. 9, pp. 723-733.

There was added to the semen and spermatozoa of hatchery-reared rainbow trout natural fresh-water, isotonic salt solution (dissolved NaCl 55.05 g, KCl 1.97 g and $\text{CaCl}_2 \cdot 2\text{H}_2\text{O}$ 3.14 g in 7.5 l. natural water), ovarian fluid, and its own urine, in varied proportions. The activities, in movement and duration, of the spermatozoa were examined under microscope. The examination was followed by discussion on their longevity referred to storage. Dilution was expressed by the relative volume of diluents (diluent/semen and spermatozoa, in volume).

The spermatozoa remain motionless unless the semen is diluted with more than a certain relative volume of diluents, and relative volume varies depending on diluents applied. An initial movement of spermatozoa is activated by treating of, in order of lesser to higher, ovarian fluid, isotonic salt solution and water.

The activity of spermatozoa treated by water is accelerated by adding more water. However, the time of the second addition enabling the movement after the first dilution is negatively proportional to the amount of water in the first dilution.

The type and duration of movement of spermatozoa varies with the amounts and kinds of diluents. In dilution with water the duration in the movement of spermatozoa is lengthened as the volume of diluent increases up to a certain extent, and then shortened gradually by further addition; while in the dilution by both isotonic salt solution and ovarian fluid the spermatozoa movement is accelerated and lengthened with the increase of diluent.

The spermatozoa treated first by ovarian fluid could be activated again intensely from gradually weakened condition and complete immobility by adding water, a uniqueness of the ovarian fluid. The fertility of spermatozoa in diluted semen with ovarian fluid could be maintained for 5 days and 7 hours after dilution.

No definite results were obtained in the spermatozoa movement by dilution with rainbow trout urine; the movement varied as in the case of dilution by water to nearly complete immobility which results from dilution by a large amount of urine. It is believed that urine has a retarding effect on the motility of the spermatozoa. Chemical nature of urine compared to sexual products is quite distinct.

Seminal plasma has no activating effect on the motility of spermatozoa. Any diluent containing seminal plasma shows a lowering of activating effect. The spermatozoa which separated from seminal plasma by centrifugation of semen (3000 r. p. m., 30 minutes) could maintain normal motility and fertility for more than 7 days at a temperature ranging from 5° to 10° C. It may be stated that the spermatozoa derived by centrifugation can stand for an extended

period. (From Auth. Abst.)

7437. Kobayasi, Hisao, and Hazime Toya (Dept. Biol., Aiti Gakugei Univ., Okazaki, Japan). 1964. STUDIES ON THE DEVELOPMENT OF CTENII IN THE CTENOID SCALES OF RED SEA BREAM, *CHRYSOPHRYS MAJOR* T. ET S. Bulletin of the Japanese Society of Scientific Fisheries, Vol. 30, No. 9, pp. 711-716.

The developmental process of ctenii in the ctenoid scales of Red Sea bream, *Chrysophrys major* Temminck et Schlegel, in comparison with that of common sea bass, *Lateolabrax japonicus* Cuvier et Valenciennes, was observed and the following results were obtained.

In this fish, another example was found of a similar destruction phenomenon in fully formed spine of ctenoid scales to what was ascertained in that of common sea bass (Kobayasi and Miwa, 1964). But in this species, they formed a split between the proximal and the middle portion of spine just before the starting of destruction phenomenon, and a similar split emerged between the middle and the distal pointed portion some time after the formation of primary split.

Another destruction was observed that excluded from the distal portion in an anterior direction on either side of the previously mentioned split.

On the observation by sectioned materials, the scale increases in size and thickness by the addition of scale substance in the direction of scale margin and lower surface, but it does not on the upper surface.

This coincides with studies of goldfish by Hiyama and Ichikaya (1954) and Yamada (1961), but not with the contents of Hase's paper (1911).

If Hase's opinion is correct, the old spinal bases of the ctenoid scale should be imbedded in the scale substance, but our observation did not show this. (From Auth. Abst.)

7438. Ochiai, Akira, and Toranosuke Yoshimitsu (Dept. of Fish. Fac. of Agriculture, Kyoto Univ., Kyoto, Japan). 1964. ON THE POPULATION AND MIGRATION OF ADULT RED SALMON IN THE WESTERN PARTS OF THE NORTH PACIFIC AND BERING SEA, AS ESTIMATED BY AGE COMPOSITION. Bulletin of the Japanese Society of Scientific Fisheries, Vol. 30, No. 9, pp. 734-741.

The distributional pattern of red salmon migrating to Japanese fishing grounds in the summer of 1960 was examined on the appearance of dominant age groups. The samples used for this purpose were obtained every five days from various areas limited by longitude 1° and latitude 1°, respectively. The population examined first, which belonged apparently to the East Kamchatka type, was dominant during the period between May and late June in the North Pacific waters from the southeastern coast of Kamchatka to nearly as far east as longitude 173° E, with their southern bounds in latitude 47°-48° N. This population was chiefly composed of the 52 and the 63 age groups of salmon which were in the ocean 3 years. Those

red salmon migrating to Olyutorskii District were dominant late in June in the western part of the Bering Sea bounded by 58°-60° N and 171°-178° E, mainly represented by the 5₂ and the 6₃ age groups, as was seen in the East Kamchatka salmon.

The West Kamchatka red salmon, mainly composed of the 5₃ or the 4₂ age group in the ocean 2 years, seemed to have migrated from farther south to the northern limits of the North Pacific, west of longitude 174° E. The 5₃ age group appeared rather plentifully first in early June in the waters bounded by 46°-48° N and 160°-170° E, and then rapidly extended northward, until in July the group was seen in nearly all the waters where salmon of the East Kamchatka type had been found abundantly in May or June. The 4₂ age group was dominant from the middle to the end of July in waters where the 5₃ age group had been plentiful in June and July. Red salmon, which have their origin in the Bristol Bay, Alaska, made their appearance in May or in June in the Bering Sea and the waters around the Aleutian Islands, lying between 50°-56° N and 171° E-178° W. In 1960 the 4₂ age group was dominant in number. (From Auth. Abst.)

7439. Higashi, Hideo, Tokugoro Kaneko, Seinosuke Ishii, Isao Masuda (Okutama Branch, Tokyo Pref. Fish. Exper. Sta., Tokyo, Japan), and Takao Sugihashi. 1964. EFFECT OF DIETARY LIPID ON FISH UNDER CULTIVATION. I. EFFECT OF LARGE AMOUNTS OF LIPID ON HEALTH AND GROWTH RATE OF RAINBOW TROUT. Bulletin of the Japanese Society of Scientific Fisheries, Vol. 30, No. 9, pp. 778-785.

It is usually assumed that a large amount of oil in the food of hatchery fish is harmful. However, there are reasons to believe that oil kept in good quality is not detrimental.

To prove this point, breeding experiments of rainbow trout (*Salmo irideus*) were undertaken for six months in 1961.

The kinds of oil used were fin whale oil and residual oil from molecular distillation of vitamin A of Alaska pollack liver oil. In this experiment, the fish were divided into four groups, A to D. Groups A to C were fed with diets containing both oils at the same levels, 2.5, 7.5 and 12.5 percent, respectively. Group D had the diet containing the fin whale oil at 13 percent but not the other oil.

The experiment was carried out in two periods: the first period was from January 27 to April 18 and the second was from April 19 to July 19, 1961.

Feeding was continued until the fish began to reject the offering.

The experiment revealed that if the dietary oil was protected from oxidation or decomposition, the fish could be reared in good health with low mortality even when they were fed with a large amount of oil.

Measurement of the oil contents in different parts of the fish indicated an increase of the oil contents in the flesh, adipose tissue of viscera, liver and kidney with the progress of the feeding period.

The ratios of the oil contents in these parts

were comparable to the oil in the diet.

In the first period of the experiment, the groups of fish which grew faster than any other groups were B and D fed with the diet containing 15 percent oil; in the second period, it was group C fed with the diet of 25% oil.

These phenomena may be attributed to any of the following reasons or their combinations: (a) in the earlier months of the experiment the water temperature was lower, (b) the fish were smaller in those months, and (c) in the later months they became accustomed to the diet of a high oil content. (From Auth. Abst.)

7440. Ballard, W. W. (Dept. of Biological Sciences, Dartmouth Coll., Hanover, New Hampshire), and R. G. Needham. 1964. NORMAL EMBRYONIC STAGES OF *POLYODON SPATHULA* (WALBAUM). Journal of Morphology, Vol. 114, No. 3, pp. 465-477.

The embryonic development of *Polyodon spathula* is like the development of sturgeon embryos in nearly all details. Detlaf and Ginsburg ('54) defined 36 stages of sturgeon embryology from fertilization to hatching, including five pairs defined by trivial characters. For *Polyodon* each of these pairs is reduced to one. Otherwise, a nearly exact correspondence exists between the stages in both studies. In this investigation, ten more stages were added beyond hatching, to carry the account of *Polyodon* development to the onset of feeding. The age of each stage is given in hours or days from fertilization.

As in sturgeon, *Polyodon* cleavage is total and unequal, and the gastrulation involves an amphibian-like cytoplasmic crescent, a blastopore, yolk plug, and gastrocoel. In contrast to conditions in holosteans and teleosteans, the yolk mass is contained within the blastomeres, and the liver grows out ventral to the yolk mass, not dorsal to it.

A conspicuous feature of the late neurula stage is a long hairpin-shaped excursion of the primitive kidney duct, from which the pronephros is derived. Only in sturgeons has a similar development been found.

Relatively huge nasal organs contrast with extremely small eyes. The latter complete their histogenesis with very little increase in size beyond that of the optic vesicles. The caudad migration of the lateral line placode is exceptionally clear.

Development of the gut, and of the hypaxial muscles, takes a different course in the part of the trunk filled at first by the yolk mass, compared with the part formed by the projecting trunk-tail bud. (Auth. Summ. and Concl.)

7441. Quast, Jay C. (U. S. Bur. Comm. Fish. Biol. Lab., Auke Bay, Alaska). 1965. OSTEOLOGICAL CHARACTERISTICS AND AFFINITIES OF THE HEXAGRAMMID FISHES, WITH A SYNOPSIS. Proceedings of the California Academy of Sciences, Fourth Series, Vol. XXXI, No. 21,

pp. 563-600, 3 figs.

Representatives of hexagrammid genera are analyzed for skeletal features, and the findings compared with original and published data on other mail-cheeked fishes (suborder Cottoidei). Perciform groups suggested in the literature as possible mail-cheeked allies are also examined. Results indicate that the fish skeleton has numerous characteristics of taxonomic importance that have been used little or not at all. Examples include caudal structure, dorsal pterygiophore patterns, and ratios between dorsal fin spines, pterygiophores, and vertebrae. Taxonomic findings indicate that the present classification of mail-cheeked fishes, based on Regan's work of 1913, is in need of revision. The Hexagrammidae and Zaniolepididae are probably primitive offshoots of the cottid evolutionary line and the three groups should be placed in the same superfamily. The zaniolepidids are generally intermediate between the hexagrammids and cottids. The Anoplopomatidae (Anoplopoma, Eri-lepis) are sufficiently distinct from the scorpaenids and hexagrammid-cottids to warrant a separate superfamily. The mail-cheeked fishes may be an artificial assemblage containing at least three distinct evolutionary lines, scorpaenid, anoplopomatid, and hexagrammid-cottid. The findings are summarized in a synopsis. (Auth. Abst.)

7442. McDowall, R. M. (Fish. Lab., Marine Dept., Wellington, New Zealand). 1964. THE AFFINITIES AND DERIVATION OF THE NEW ZEALAND FRESH-WATER FISH FAUNA. *Tuatara*, Vol. 12, No. 2, pp. 59-67.

The fresh-water fish fauna of New Zealand has been derived mostly from Australia by transoceanic dispersal of larval or adult fishes. Earlier arrivals were probably the more primitive Isospondyli - the Galaxiidae, Retropinnidae and Aplochitonidae - with the Eleotridae arriving more recently. A further emigration of Galaxiidae is suggested by the distribution pattern for *Galaxias attenuatus*. The distribution of *G. attenuatus* clearly shows that transoceanic dispersal can disperse fishes across the South Pacific Ocean to South America. This mechanism probably accounts for the fresh-water fish faunal relationships between Australasia and South America.

As Myers (1953) has said, there is nothing in the New Zealand fresh-water fish fauna to indicate land connections; the key to relationships is marine wandering. (Auth. Summ.)

7443. Nahhas, Fuad M., and Robert B. Short (Dept. of Biological Sciences, Florida State University, Tallahassee). 1965. DIGENETIC TREMATODES OF MARINE FISHES FROM APALACHEE BAY, GULF OF MEXICO. *Tulane Studies in Zoology*, Vol. 12, No. 2, pp. 39-50.

Forty-eight species of Digenea are reported from 43 species of fishes from Apalachee Bay, Florida. Three new species are described: Genitocotyle cablei (Opecoelidae), Lepocreadium brevoortiae (Lepocreadiidae) and Pseudoacanthostomum floridensis (Cryptogonimidae). Fourteen new locali-

ty records bring to 109 the species of Digenea known from Tampa Bay and the northern Gulf: 27 species from the Texas coast, 50 from Louisiana, 16 from Mississippi, 31 from Tampa and Boca Ciega Bays, and 48 from Apalachee Bay. (Auth. Abst.)

7444. Cook, Sherburne F., Jr. (Lake County Mosquito Abatement District, 410 Esplanade, Lakeport, California). 1961. FEEDING STUDIES OF THE AENEUS CATFISH, CORYDORAS AENEUS, ON AQUATIC MIDGES. *Journal of Economic Entomology*, Vol. 55, No. 2, pp. 155-157.

In an effort to find a fish suitable as a predator on the Clear Lake gnat (Chaoborus astictopus Dyar & Shannon (Diptera: Culicidae)), several species have been given laboratory study. By introducing fish into aquarium tanks with lake mud and an assemblage of bottom organisms of known quantity, it was possible to determine the number of each species eaten after a period of feeding by the fish. By far the most effective bottom feeder found was the little aeneus catfish, Corydoras aeneus (Gill). This species was found most effective against species of the midge family Chironomidae, being almost 100% effective in all tests runs. (Auth. Abst.)

7445. Cook, S. F., Jr., J. D. Connors, and R. L. Moore (Lake County Mosquito Abatement District, 410 Esplanade, Lakeport, California). 1964. THE IMPACT OF THE FISHERY UPON THE MIDGE POPULATIONS OF CLEAR LAKE, LAKE COUNTY, CALIFORNIA. *Annals of the Entomological Society of America*, Vol. 57, No. 6, pp. 701-707.

The midge, or gnat, of primary concern in this study was the Clear Lake gnat, Chaoborus astictopus Dyar and Shannon (Culicidae: Chaoborinae), a species of considerable economic concern to this area. Despite its great abundance in this environment, this gnat species was found in less than 16% of the 1940 stomachs examined from representatives of virtually every fish species occurring in Clear Lake. Chironomid midges, on the other hand, though far less abundant than chaoborids in this lake, were found in 43% of the stomachs examined. From an overall evaluation of the results obtained, an attempt was made to explain possible reasons why the Clear Lake gnat was not more heavily utilized for food. This information will provide a basis to be used in evaluating those characteristics most potentially desirable in any alien fish species under consideration for introduction into Clear Lake as a possible biological control agent of the Clear Lake gnat. (Authors)

7446. Diaz-Piferrer, Manuel. 1962. THE EFFECTS OF AN OIL ON THE SHORE OF GUÁNICA, PUERTO RICO. *Ass. Island Mar. Labs., 4th Meet., Curacao*, 18-20, Nov. 1962: 12-13; *Deep Sea Research* 11(5); pp. 855-856. 1964.

On the night of July 16, 1962, the Italian tanker Argea Prima ran aground on the reefs off Guayanilla Harbor on the south shore of Puerto Rico. Unable

to obtain assistance from any other vessel, the captain decided to pump about 10,000 tons of crude oil into the sea coincident with the incoming tide to set the vessel afloat. The oil was blown ashore and transported by currents along the beaches as far as the bay at Boqueron on the west coast of the island. Offshore coral reefs to the west also received a blanket of thick oil.

The first part of the shore affected was Guánica. The author had maintained a collecting station for algae at this site for an entire year previous to the oil 'spill' as well as from 1958 to 1959. This was one of the eleven stations around the island where ecological studies on algae were made. The principal investigation was concerned with the agarophytes of Puerto Rico, supported by The Administration for Economic Development of Puerto Rico (Fomento). The littoral zone at Guánica was characterized by a particularly rich and varied marine flora.

Having studied this area carefully, the author was able to note extensive damage caused by the oil. The most important physical damage was the heavy erosion of the beaches from the combined action of waves and oil. In some places all the sand was washed away leaving only oil-blackened, bare rock. For example, an estimated 3000 m³, of sand disappeared from Tamarindo Beach in less than a week. An analysis was made of the oil-soaked sand from beaches under erosion and out to sea to depths of about 5 m. The sand tended to form small spherical masses with the oil. Some of these globules, consisting of small particles of shell and fine sand enclosed in oil (about 50 percent by mass of oil), were nearly afloat. Denser globules 20 percent or less of oil contained larger particles of sand, gravel and shell; these remained on the bottom but tended to move seaward.

The oil striking mangrove swamps settled among the roots, and where the amount of oil was great, this habitat was virtually destroyed.

There was a tremendous mortality of marine organisms along the shore. Adult and juvenile lobsters, crabs, sea urchins, starfishes, sea cucumbers, gastropods, such as king helmets and queen conchs, octopuses, squids, a variety of fishes, particularly clupeoids, and sea turtles were found dead. It was noted that sea birds were absent from the area. The marine vegetation was seriously affected, especially the plants living in intertidal and sub-littoral zones. Large rocky areas were completely denuded of algae. Marine phanerogams, particularly *Thalassia*, were badly affected.

Economic damage was also extensive. The loss of entire beaches and large deposits of tarry oil seriously handicapped beach hotels and resorts as well as private individuals with beach cottages. This also directly affects local business dependent on tourists. The fishermen of Guánica had their gear damaged and there was an obvious depletion of the fisheries.

Monthly visits have been made to the site of the spill to check on further changes and look for signs of recovery. The oil-soaked sand is still evident on the bottom in several feet of water. Beds of *Thalassia*

have continued to degenerate. Since last October algae have repopulated the rocks and pools of the intertidal zone. In contrast to the earlier algal types, the present ones are almost entirely Myxophyceae. Among these blue-greens were detected the following: *Lyngbya semiplena*, *L. aestuarii*, *L. majuscula*, *Calothrix crustacea*, *Hydrocoleum lyngbyaceum*, *H. cantharidosmum*, *H. glutinosum*, *Entophysalis conferta*, *Dichothrix olivacea*, and *Microcoleus chthonoplastes*.

7447. McAllister, D. E. (National Museum of Canada, Ottawa, Ontario, Canada). 1964. FISH COLLECTIONS FROM EASTERN HUDSON BAY. The Canadian Field-Naturalist, Vol. 78, No. 3, pp. 167-178.

Distribution and ecological data are presented from the 1963 National Museum of Canada expedition to eastern Hudson Bay. Twenty-eight marine and fresh-water fishes are reported. The known northern limits in Quebec of *Salvelinus fontinalis*, *Prosopium cylindraceum*, *Coregonus artedii*, *Coregonus clupeaformis*, and *Catostomus catostomus* are extended. *Cyclopterus lumpus* and *Stichaeus punctatus* are reported for the first time from eastern Hudson Bay. (Auth. Summ.)

7448. Farnes, Phillip E. (Soil Cons. Service, Bozeman, Montana), and Ross V. Bulkley. 1964. FISHERY MANAGEMENT OF YELLOWSTONE LAKE, WYOMING, AS RELATED TO WATER SUPPLY FORECASTS. Proceedings Western Snow Conference 1963, pp. 27-31.

Snow survey data used in early season forecasts for Yellowstone Lake levels may aid in managing this sport fishery for optimum production. Foreknowledge of spawning conditions through these early season forecasts allows sufficient time to prepare artificial spawning facilities, if desired, should conditions for natural production be unsuitable.

Since the Soil Conservation Service makes water supply forecasts based on snow survey data for most gaged streams and rivers in the western United States, procedures and methods discussed in this paper may be adapted for better management of many other fisheries. (From Auth. Summ.)

7449. Williams, H. Harford (Commonwealth Bur. of Helminthology, St. Albans, Australia). 1964. SOME NEW AND LITTLE KNOWN CESTODES FROM AUSTRALIAN ELASMOBRANCHS WITH A BRIEF DISCUSSION ON THEIR POSSIBLE USE IN PROBLEMS OF HOST TAXONOMY. Parasitology, 54(4): pp. 737-748.

One diphyllidean and five tetraphyllidean cestodes from Australian elasmobranchs are described and figured. *Echinobothrium heroniensis* sp. nov., from *Himantura granulata* (Macleay, 1883) possesses two groups each of 42 apical hooks, eight rows each of 25 hooks on the cephalic peduncle and ten testes in each proglottid. In *Anthobothrium sexorchidum* sp. nov. from *Tetrarhynchus lymna* (Forskal, 1775) there are only six testes and the bothridium is

irregularly divided into a number of shallow areolae while in Rhinebothrium himanturi sp. nov. from Himantura granulata there are 22 proglottids, 52 loculi and 19-20 testes. Comments are made on the taxonomy of Rhinebothrium sp., Spiniloculus maven-sis, and Yorckeria parva. The value of some helminths, especially cestodes from elasmobranchs, as an aid to the study of the taxonomy, biology, and zoogeography of their hosts is briefly discussed with reference to some previous papers on this topic. Previous work on the cestodes of Australasian marine fishes is summarized briefly. (Auth. Summ.)

7450. Kulda, Jaroslav, and Jiri Lom (Dept. of Protozoology, Inst. of Parasitology, Czechoslovak Academy of Sciences, Prague). 1964. REMARKS ON THE DIPLOMASTIGINE FLAGELLATES FROM THE INTESTINE OF FISHES. *Parasitology*, 54(4): pp. 753-762.

In the intestine of fresh-water fishes, two morphologically different types of diplomastigine flagellates have so far been found to exist: Hexamita salmonis (Moore, 1920) specific for fishes, and Spiro-nucleus elegans Lavier, 1936, identical with the flagellate from amphibia.

The identity of the Spiro-nucleus from fishes and amphibia has been demonstrated by infecting Pterophyllum scalare with flagellates from newts per os, per rectum and with contaminated food.

A redescription of motile stages of both Hexamita salmonis and Spiro-nucleus elegans is presented, together with a list of existing findings of fish diplomastigines, and a brief discussion. (Auth. Summ.)

7451. Batts, Billy W. (Dept. of Natural Sciences, Longwood Coll., Farmville, Virginia). 1964. LEPID-
OLOGY OF THE ADULT PLEURONECTIFORM
FISHES OF PUGET SOUND, WASHINGTON. *Copeia*, 1964, No. 4, pp. 666-673.

An analysis of scales from flatfishes of Puget Sound was accomplished by using such morphological characters as radii, circuli, markings between circuli, position of focus, and ctenii. Twelve regions for selecting scales were used, 6 from the eyed side and 6 from the blind side. The plastic impression method proved satisfactory for analyzing scale characteristics. The occurrence of the cycloid and ctenoid scales on 12 body regions is presented. A key based on the morphological scale characteristics was designed to distinguish the species of flatfishes found in Puget Sound. (Auth.)

7452. Weisel, George F., and Eldon L. McLaury (Dept. of Zool., Montana State Univ., Missoula). 1964. BLIND CATFISH (ICTALURUS NEBULOSUS) FROM DOG LAKE, OREGON. *Copeia*, 1964, No. 4, pp. 687-690.

Blind Ictalurus nebulosus have been taken from Dog Lake, Oregon, for a number of years. In a recent catch of 14, 1 had apparently normal eyes, 7 had no external evidence of eyes, and 6 had the left eye only. The lake is boggy with some overhanging banks. Functional eyes seem to be of little or no selective value to catfish in this habitat. A descrip-

tion of the microphthalmic eyes is given. Little differentiation of the embryonic optic vesicle took place in them after formation of the pigment layer and retina. (Authors)

7453. Richards, William J. (U. S. Bur. Comm. Fish., Biol. Lab., Bldg. 74, Navy Yard Annex, Washington, D. C. 20390), and Leslie W. Knapp. 1964. PERCINA LENTICULA, A NEW PERCID FISH, WITH A REDESCRIPTION OF THE SUBGENUS HADROPTERUS. *Copeia*, 1964, No. 4, pp. 690-701.

A new species of Percina from the Alabama River system is described and compared with P. nigrofasciata and P. sciera, the other 2 members of the subgenus Hadropterus. The new species has a distinctive color pattern and small scales (lateral line scales 77-90). The nomenclatural history of Hadropterus is reviewed and this subgenus is diagnosed and redescribed. (Authors)

7454. Ali, M. A. (Dept. of Biology, Univ. Montreal, Montreal, Canada), and Isao Hanyu. 1964. OCCURRENCE OF MULTIPLE LENSES IN THE EYES OF BROWN BULLHEAD (ICTALURUS NEBULOSUS). *Copeia*, 1964, No. 4, pp. 704-705.

7455. Schwartz, Frank J. (Chesapeake Biol. Lab., Univ. of Maryland, Solomons). 1964. FISHES OF ISLE OF WIGHT AND ASSAWOMAN BAYS NEAR OCEAN CITY, MARYLAND. *Chesapeake Science*, Vol. 5, No. 4, pp. 172-193.

The occurrence of 104 species of fish belonging to 54 families and 87 genera in the Isle of Wight and Assawoman Bays near Ocean City, Maryland, is reported. These fish were collected in 1959, 1961, 1962, and 1963 by various gear. Each species is accompanied by some ecological notes pertaining to seasonal oscillations of species and populations, patterns of distribution in the bays, etc. (Auth.)

7456. Miller, Robert Victor (Chesapeake Biol. Lab., Natural Resources Inst., Univ. of Maryland, Solomons). 1964. THE MORPHOLOGY AND FUNCTION OF THE PHARYNGEAL ORGANS IN THE CLUPEID, DOROSOMA PETENENSE (GUNTHER). *Chesapeake Science*, Vol. 5, No. 4, pp. 194-199.

A pair of suprabranchial or pharyngeal organs were discovered while studying the food habits of the threadfin shad, Dorosoma petenense, in 1959. Plankton was found in these structures and was counted separately from that found in the stomach. The morphology and histology of the organs indicated that apparently they were used for the accumulation and temporary storage of small food organisms which were coalesced into a bolus and later swallowed. (Auth.)

7457. Finucane, John H. (U. S. Bur. Comm. Fish. Biol. Sta., St. Petersburg Beach, Florida). 1964. DISTRIBUTION AND SEASONAL OCCURRENCE ON GYMNODINIUM BREVE ON THE WEST COAST OF FLORIDA, 1954-57. U. S. Fish and Wildlife Service Special Scientific Report--Fisheries No. 487,

14 pp.

The distribution and seasonal occurrence of *Gymnodinium breve*, the Florida red-tide organism, was recorded for a 4-year period in estuarine and neritic waters along the Florida west coast. *G. breve* was found throughout the year in the area from Tarpon Springs south to the Florida Everglades. Blooms of this dinoflagellate occurred mainly from September through December in 1954 and 1957. Essentially, both 1955 and 1956 were not red-tide years. The observed salinities, temperatures, and distribution of *G. breve* are presented during both bloom and nonbloom periods. (Auth. Abst.)

7458. Barkley, Richard A., Bernard M. Ito, and Robert P. Brown (Bur. Comm. Fish. Biol. Lab., Honolulu, Hawaii). 1964. RELEASES AND RECOVERIES OF DRIFT BOTTLES AND CARDS IN THE CENTRAL PACIFIC. U. S. Fish and Wildlife Service Special Scientific Report--Fisheries No. 492, 31 pp.

Since January 1961, the Bureau of Commercial Fisheries Biological Laboratory in Honolulu has been releasing drift bottles and cards in the central Pacific Ocean. Data are presented on all releases and recoveries through June 1963, together with charts showing the release and recovery points. An analysis of the returns from the Hawaiian Islands shows that there is a seasonal change in the direction and speed of the current system near the Islands which coincides with changes in strength of the trade wind system. During the first half of the year the current moves at speeds of between 6 and 11 nautical miles per day and near Oahu and Kauai it moves toward the northwest, while in the latter half of the year the speed is 6 nautical miles per day or less, and the direction of flow is toward the west or somewhat south of west. (Authors)

7459. Eipper, Alfred W. (Fernow Hall, Cornell Univ., Ithaca, New York). 1964. GROWTH, MORTALITY RATES, AND STANDING CROPS OF TROUT IN NEW YORK FARM PONDS. Cornell Univ. Agricultural Experiment Station Memoir 388, 67 pp.

Studies were conducted from 1952 through 1958 to determine the reproduction, growth, natural mortality, fishing potential, and standing crops of trout in 70 central New York farm ponds.

The usual experimental approach was to stock trout as spring fingerlings (age 0) or fall fingerlings (age 0+) in series of ponds at stocking rates varying from 200 to 800 per acre, and to determine survival and growth in each pond in successive half or whole years by spring and/or fall population inventories. Standard inventory procedure involved seining a pond twice with a 150-foot bag seine for a Petersen population estimate; inventories of 15 ponds stocked 11 to 26 days earlier with known numbers of trout indicated that population estimates were nearly always accurate to within 10 percent. In the average pond inventory, fish actually counted comprised about 80 percent of the estimated population.

Of the 195 pond inventories from which usable

data were obtained in the 7-year study, brook trout were the single or dominant species in 141, rainbow trout in 46, and brook X brown trout hybrids in 8. Fragmentary data on brook X lake trout hybrids and a wild strain of brook trout are also available. Saila (1952) had previously determined that brown trout are unsuitable for New York farm ponds because of their pronounced invulnerability to angling in these waters.

Survival of brook X brown trout hybrids from fertilized egg to free-swimming fry was approximately 17 percent. Brook X lake trout hybrids showed about 75 percent survival from egg to fry, but there was some evidence that they may be less well suited to New York farm ponds than many salmonids because of lower temperature tolerance. Wild and domestic brook trout did not differ appreciably in survival or growth in 3-year tests involving equal numbers of both strains in each of 2 ponds.

Nearly all farm ponds lacked suitable environmental conditions for successful trout reproduction, although brook trout frequently spawned.

Growth of a given trout pond population in a given time interval was measured by increment in mean length, increment in mean weight, and the coefficient of growth in mean weight ("instantaneous growth rate"). Weight increment was a better measure of growth than length increment or growth coefficient, in that it was less size-specific, and was somewhat more sensitive to changes in mean population density and to seasonal influences. Growth in a given time interval was inversely related to mean size of trout at the start of the interval. Growth was not related to population density or biomass at the start or end of an interval; mean population density inversely affected growth, but the relationship was very poorly defined in fish populations below age I+. Fall fingerling trout stocked in farm ponds at age 0+ attained an average length and weight, respectively, of 10.1 inches and 0.50 pounds at age I+; 14.2 inches and 1.35 pounds by age III+.

There were no differences in natural mortality rate between brook, rainbow, or brook X brown hybrid trout of comparable ages. Natural mortality rate was not detectably related to the number, biomass, or size of trout present at the start of a given age interval. Mortality of spring fingerlings was extremely variable and fall fingerling plantings gave more dependable results, particularly when older fish from an earlier plant were present. Natural mortality rate varied markedly with calendar year, season, age of fish, and pond water supply. Duration of bottom water temperatures above 73° F was the factor that most influenced the natural mortality of farm pond trout in central New York. Mean natural mortality rates of trout in the first, second, and third years after stocking as fall fingerlings were 0.60, 0.80, and 0.80, respectively.

Brook X brown trout hybrids were most vulnerable to angling, brook trout next, and rainbows the least vulnerable.

Data indicate that New York farm ponds are providing a total catch of about 185,000 trout per year. The average rate of exploitation was 0.22, and most of the ponds could have been harvested much more intensively.

Mean growth and natural mortality rates were used to determine expected standing crop in each half year of pond life, in the absence of fishing. These computations indicate that an average planting of 600 fall fingerling trout (42 pounds) per acre in an average, unfished, central New York farm pond reaches a maximum biomass of 115 pounds per acre a year later (age I+), at which time 230 ten-inch trout remain. Standing crops in the succeeding 2 years would average 46 trout (41 pounds) per acre at age II+, 9 trout (12 pounds) per acre at III+. The validity of these computed mean standing crops is supported by the empirical data; a pond stocked with 750 fall fingerling trout per acre contained 665 fish (240 pounds) per acre a year later.

Because they do not permit trout reproduction, most New York farm ponds must be restocked every other year to maintain satisfactory fishing. Fall fingerlings are more economical and more reliable than spring fingerlings for this purpose. (From Auth. Summ.)

7460. McKenzie, R. A. (Fish. Res. Bd. of Canada, Biol. Sta., St. Andrews, N. B., Canada). 1964. SMELT LIFE HISTORY AND FISHERY IN THE MIRAMICHI RIVER, NEW BRUNSWICK. Fisheries Research Board of Canada, Bulletin No. 144, 77 pp.

The results of smelt investigations on the Miramichi River, N. B., from 1941 to 1963 are analyzed and reviewed. Subjects covered include: the life history including migrations, races, spawning, and the effects of rainfall and crowding on survival; and the fishery including statistics, fishing practices, the size, age and maturity of the fish, the intensity of the fishery, and the effects of mesh size of nets on the catch. Special consideration is given to conclusions derived from marking studies on the supply of fish to the fishery and the relationship between smelt spawning at different times and in different brooks, and to deductions from vertebral counts and scale studies.

Little movement was found out of Miramichi to other river systems or from side to side of Miramichi Bay during the winter, but restricted "homing" to marking districts occurred. The spawning run begins before the ice leaves, reaches the head of tide late in April, and lasts until early June. Spawning grounds are occupied in the same order each year, first the headwaters and large tributaries then the smaller ones. Males predominate among the spawners, arrive first, and stay longest; many die during spawning. Female smelt, with a slightly faster growth rate than the males, contain from about 8,000 to 50,000-60,000 eggs, and spawn chiefly at night; the eggs stick to everything they touch, the outer coat becoming a "stickfast" after short contact with water. Heavy mortality occurs among crowded eggs, the percentage larval production declining as crowding increases; the

optimum larval yield is calculated to occur at an egg density of about 12,000 per square foot. A negative correlation exists between rainfall and larval production. Smelt larvae are repelled by light. The average size of each age class of spawners, as well as the number of ridges in the first-summer zones on their scales, declines as spawning progresses, while the average vertebral count increases. The spawners, maturing at age 2, are 66% 2-year-olds, 30% 3-year-olds and the rest 4-, 5-, and 6-year-olds.

Total smelt landings, made almost entirely with trap nets set through the ice, declined irregularly during the last 25 years. The catch per net declined also to 1945, then remained steady until a 32-year maximum occurred in 1962-63. The catch, frozen on the ice, is graded commercially into medium, number one, and extra grades. The less desirable medium grade can be reduced to 50% by increasing the mesh size of the net from the legal 1-1/8 inch mesh for box nets to 1-1/2 inch mesh. There is no minimum legal size for smelt. The average size of the fish declines as the fishery progresses, the catch consisting mainly of age 2 (62%) and age 3 (32%) fish.

Vertebral counts, first-year scale ridges, and recoveries of marked fish indicate that both early and late spawners contribute to the fishery. Marked-fish recoveries also indicate that large numbers of smelt enter the Miramichi after the fishery and calculations show that the total Miramichi stock may be approximately 375 million fish with only about 4% being caught yearly.

Suggestions for conservation and management include clearance of spawning streams, prohibition of fishing in certain areas while lengthening the fishing season, and the separate exploitation and regulation of the smelt stock in different rivers. (Auth. Abst.)

7461. Lloyd, R., and D. H. M. Jordan. 1963. PREDICTED AND OBSERVED TOXICITIES OF SEVERAL SEWAGE EFFLUENTS TO RAINBOW TROUT. J. Inst. Sew. Purif., Pt. 2, 167-173; Water Pollution Abstracts, Vol. 37, No. 8, Abst. No. 1374. 1964.

Recent experiments on the toxicity to fish of mixtures of poisons have suggested that the toxicity of a sewage effluent might be the sum of the toxicities of the individual poisons present. Further experiments have now been carried out to determine the extent to which the toxicity of sewage effluents could be accounted for from the concentrations of the poisons commonly present (ammonia, phenol, heavy metals, and perhaps cyanide) for which the method of analysis is relatively simple and whose toxicity to rainbow trout is known. The results, given in tables and graphs, showed that there was reasonable agreement between the observed toxicities of effluents and the toxicities predicted from their composition. The advantages of the predictive method, which can be adapted to allow for variations in the environment, including hardness of the receiving

stream and temperature, are discussed, and its practical application to the determination of the 3-day toxicity index of effluents is illustrated.

7462. Reimann, K. 1962. HARMFULNESS OF OIL AND TAR PRODUCTS TO LOWER WATER ORGANISMS. Munch. Beitr. Abwass.-, Fisch.- u. Flussbiol., 9, 60-72; LitBer. Wass Abwass. Luft u. Boden, 1962/63, 11, 194; Water Pollution Absts., Vol. 37, No. 8, Abst. No. 1375. 1964.

The author summarizes present knowledge of the harmfulness of oil and tar products to lower water organisms. Oil films hinder respiration of surface-breathing organisms and the gills of underwater breathing organisms may become coated with oil; joints of rapidly moving animals may become clogged; and unicellular algae may be damaged and sink to the bottom. Biological decomposition on the bottom is hindered by the action of oil on the sludge. The effects of toxic and carcinogenic constituents of hydrocarbons are described.

7463. Hickling, C. F. 1963. BREEDING FISH IN THERMAL POWER STATION COOLING WATER. World Pwr Engng, 1, No. 5, 47-48; Water Pollution Abstracts, Vol. 37, No. 9, Abst. No. 1493. 1964.

The author discusses the utilization of waste heat in cooling water from power stations for the commercial culture of fish for food in Great Britain, with particular reference to climatic restrictions, European experience, limitations for rainbow trout production, and the suitability of African *Tilapia* fish for this purpose.

7464. Butler, J. L. 1964. INTERACTION OF EFFECTS BY ENVIRONMENTAL FACTORS ON PRIMARY PRODUCTIVITY IN PONDS AND MICRO-ECOSYSTEMS. Thesis, Oklahoma State University, Stillwater, Okla., 98 pp.; Water Pollution Abstracts, Vol. 37, No. 10, Abst. No. 1570. 1964.

Results are given of studies on the primary productivity, community respiration, ratio of productivity to respiration, and efficiency in farm ponds with different rates of water exchange in Oklahoma, and the effects of environmental factors on productivity were investigated in laboratory micro-ecosystems. It was found that primary productivity in the ponds varied inversely with the rate of water exchange and turbidity and appeared to vary directly with the concentration of dissolved inorganic solids. In summer, gross productivity ranged from 0.5 to 5.0 g oxygen per m² day in turbid ponds and from 3.0 to 17.0 g oxygen per m² day in clear ponds. Both the productivity:respiration ratio and the efficiency were directly related to gross productivity, and ranged from 0.7 to 2.3 and from 0.03 percent to 2.0 percent, respectively. In the laboratory experiments, productivity was found to be affected by the interactions between light intensity and total dissolved inorganic solids, light intensity and temperature, temperature and dissolved solids, and turbidity and dissolved solids; light, temperature and dissolved solids also had independent effects on productivity.

7465. Ahuja, S. K. 1964. SALINITY TOLERANCE OF *GAMBUSIA AFFINIS*. Indian J. exp. Biol., 2, 9-11; Water Pollution Abstracts, Vol. 37, No. 10, Abst. No. 1679. 1964.

The maximal salinity tolerance of the freshwater mosquitofish (*Gambusia affinis*) was determined by exposing acclimated fish to various concentrations (1.0-8.0 percent total salinity) of salt solutions containing sodium chloride, potassium chloride, calcium chloride, magnesium sulphate, sodium sulphate, and sodium bicarbonate. It was found that, at 20°-23° C, about 50 percent of the fish were able to withstand a salinity of 5 percent. Mortality increased with higher salinities; only about 5 percent of the fish were able to withstand salinities as high as 8 percent for periods of 35-41 days. Increased mortality occurred at lower (6°-7° C) temperatures. During the experiments it was also observed that fish were able to survive in water with negligible concentrations of dissolved oxygen (0.18-0.22 ppm) and did not appear to be adversely affected by high concentrations of carbon dioxide (13.75-69.30 ppm).

7466. Henderson, C., and Q. H. Pickering. 1963. USE OF FISH IN THE DETECTION OF CONTAMINANTS IN WATER SUPPLIES. J. Amer. Wat. Wks Ass., 55, 715-720; Water Pollution Abstracts, Vol. 37, No. 11, Abst. No. 1858. 1964.

The authors describe the design and operation of a system for continuous monitoring of the presence of toxic substances in a water. The water, dechlorinated if necessary with sodium thiosulphate and heated with an immersion heater to about 25° C if warm-water species of fish are used, is allowed to flow continuously through the test tank containing the fish. In some cases it may be desirable to use more than one species at a time in the test tank, since there may be considerable variation in the sensitivity of species to different types of toxicants; suitable species are indicated. The presence of toxic substances will be indicated by a change in skin color, erratic movements, loss of equilibrium, and death of a significant number of fish. Chemical analyses can then be used to identify the toxic substance and determine its source.

7467. Podubsky, V. 1958. THE DISSOLVED OXYGEN CONTENT OF WATER AND ITS EFFECT ON THE RESPIRATION OF FISH. Cslke Ryb., 13, 9; Sci. Pap. Inst. chem. Technol., Prague, Technol. Wat., 1961, 5, Pt. 1, 550; Water Pollution Abstracts, Vol. 37, No. 11, Abst. No. 1859. 1964.

Information is given on the effect of dissolved oxygen concentration on the respiration of various species of fish. When the oxygen saturation is normal, trout take 50-60 breaths per minute and carp 30-40, but at low concentrations of oxygen, the respiration is accelerated.

7468. Fedii, S. P. 1962. EFFECT OF COMMERCIAL POLLUTION ON LIVING CONDITIONS OF FISH IN THE RESERVOIRS OF THE DNEPROVSK

CASCADES. Vopr. ecol., Vyssh. Shkol., Moscow, 5, 228-230; Biol. Abstr., 1964, 45, 1120; Water Pollution Abstracts, Vol. 37, No. 11, Abst. No. 1860. 1964.

About 1 mil. m³ of trade waste waters are discharged daily into the Dneprovsk Reservoir and 400,000 m³ into the Kakhovsk Reservoir. As a result, the transparency of the water has changed from 100 to 30 cm in the Dneprovsk Reservoir and from 450 to 150 cm in the Kakhovsk Reservoir. In addition, there has been an increase in the concentration of ammonia from 0.283 to 37.65 mg per liter, in arsenic from 0.0054 to 0.018 mg per liter, and in phenols from 0.0022 to 0.08 mg per liter. To reduce this pollution the author recommends installation of recirculating water systems in the industrial plants.

7469. Mann, H. 1963. SILO WATER--A DANGER FOR FISHERY WATERS. Fischwirt, 13, 50-51; LitBer. Wass. Abwass. Luft u. Boden, 1962/63, 11, 268; Water Pollution Abstracts, Vol. 37, No. 11, Abst. No. 1861. 1964.

Drainage from silos, even in small amounts, is dangerous to fish in streams. Silage effluent is generally acid in reaction and has high concentrations of ammonia and organic matter. The danger to fish lies in the toxicity of the ammonia and in the oxygen deficiency caused by decomposition of the organic matter. It is recommended that silage effluents should be collected in pits and used on land.

7470. Herbert, D. W. M., and J. M. Richards. 1963. THE GROWTH AND SURVIVAL OF FISH IN SOME SUSPENSIONS OF SOLIDS OF INDUSTRIAL ORIGIN. Int. J. Air Wat. Pollut., 7, 297-302; Water Pollution Abstracts, Vol. 37, No. 11, Abst. No. 1862. 1964.

The authors give results of studies on the effects of wood fibers and coal-washing wastes on fish and summarize the results of an inquiry made of River Boards and other interested authorities on the effects which discharges of waste solids have on the fisheries in rivers known to them. The answers to the questionnaire indicate that there are some rivers which support reasonable fish populations even though the suspended-solids concentration is often about 200 ppm.

7471. Fontaine, Y. A., and A. Aeberhardt (Mus. Hist. Nat., Paris, France). 1963. EXPERIMENTAL LABORATORY STUDY OF THE RADIOACTIVE CONTAMINATION BY CERIUM-144 OF A COMPLEX FRESH-WATER COMMUNITY. (ETUDE EXPERIMENTALE DE LA CONTAMINATION RADIOACTIVE PAR LE CERIUM 144 D'UNE COMMUNAUTE COMPLEXE D'EAU DOUCE REALISEE EN LABORATOIRE.) Hlth. Phys. 9(11): 1047-1056. Illus. (English summ.) Biological Abstracts, Vol. 45, No. 11, Abst. No. 44982. 1964.

In a 41-day study on radioactive cerium-144 contamination of a complex fresh-water community, the kinetics of contamination were ascertained in separate members of the community. The cerium-144 is rapidly extracted from the water by fixation

on all solids and living organisms, particularly on green algae and water fleas (*Daphnia*). Internal contamination of fish and molluscs is slight, but they are exposed to intense irradiation, due to the cerium-144 in their digestive tracts. Eighteen days after introduction the concentration of cerium-144 in the algae, water fleas, mollusc viscera and contents of the digestive tracts of the fish varied between 20 and 300 times the initial radioactivity (per g) of the water. Viscera of molluscs undergo irradiation estimated at 215 rad/day, for an initial contamination of the water of 0.02 µc/g. (Authors)

7472. Picciolo, Anthony R. (Natl. Oceanogr. Data Ctr., Washington, D. C.). 1964. SEXUAL AND NEST DISCRIMINATION IN ANABANTID FISHES OF THE GENERA COLISA AND TRICHOGASTER. Ecol. Monogr. 34(1): 53-77; Biological Abstracts, Vol. 45, No. 11, Abst. No. 45094. 1964.

Reproductive behavior, with special emphasis on sexual discrimination was studied in *Colisa lalia*, *Colisa fasciata*, *Trichogaster trichopterus*, and *Trichogaster leerii*. Experiments utilizing models and live fishes with altered appearance and/or restraints upon behavior have shown that the cues responsible for sexual and nest discrimination are primarily visual. These include color patterns, configuration and movements. The activation of nest-building behavior may be stimulated in several ways and is dependent upon internal and external factors. The presence of a female, a genuine nest, or an artificial nest can stimulate nest-building behavior. (Auth.)

7473. Bozhko, A. M. 1962. ECOLOGICAL-PHYSIOLOGICAL VARIABILITY OF INTERNAL ORGANS OF FISHES IN RELATION TO AGE AND SEX. (VOZRASNAYA, POLOVAYA I EKOLOGO-FIZIOLOGICHESKAYA IZMENCHIVOST' VNUTRENNIKH ORGANOV RYB.) In: Gidrobiologicheskoe issledovaniya. (Hydrobiological studies.) Tartu. 3: 284-286; (Estonian and German summ.) Referat. Zhur., Biol., 1963, No. 1413. (Translation) Biological Abstracts, Vol. 45, No. 11, Abst. No. 45213. 1964.

A study was made of the development of the heart, liver, spleen, intestines, and gills of female and male pike, roach, and perch (1160 specimens) from oligotrophic, eutrophic, and dystrophic lakes. Variations in the degree of development of various organs are related to ecological conditions. It is proposed that they be used as bases for an ecological classification of fishes.

7474. Geagan, Donald W. (Bur. Sport Fish. and Wildlife, Atlanta, Georgia). 1963. AN ECOLOGICAL SURVEY OF A DISTURBED NATURALLY ACID STREAM. Southwestern Nat. 8(3): 127-141. Illus. Map.; Biological Abstracts, Vol. 45, No. 11, Abst. No. 45220. 1964.

Bayou Lacombe is a stream 36 miles long located in St. Tammany Parish, Louisiana. A section of it was dredged in 1952 to facilitate drainage. At the headwaters during periods of flooding it

resembles a swampy slough. In the section which was dredged, the stream is relatively fast-flowing with a sandy bottom; below this it takes on the characteristics of a coastal bayou. The stream is naturally acid with pH determinations as low as 5.2. This acidity is due to the presence of free CO₂ and the organic acid which accumulates at the upper regions of the stream. No carbonate alkalinity is present. Bicarbonate alkalinity is present in only limited quantities with the lowest concentrations in the upper regions of the stream. The lower stations show signs of being affected by tidal waters from Lake Pontchartrain, into which the bayou flows. The chemical and physical conditions of the stream are affected by the volume of water present and this in turn is controlled by rainfall. Present physical and chemical conditions more closely resemble those reported immediately after the dredging than those prior to it. However, the similarity in the number and types of organisms collected in 1957-1958 and those collected prior to the disturbance indicates a considerable degree of recovery. (Auth.)

7475. Gusev, A. G. 1962. EFFECT OF SEWAGE FROM THE COAL-TAR CHEMICAL INDUSTRY ON FISHERIES AND AQUATIC ORGANISMS. (VLIYANIE STOCHNYKH VOD KOKSOKHIMICHESKIKH ZAVODOV NA RYB BOKHOZYAISTVENNYE VODOEMY I VODNYE ORGANIZMY.) Nauchn.-Tekh. Byul. Gos. Nauchn.-Issled. Inst. Ozerogo i Rechnogo Rybn. Khoz. 16. 60-64; Referat. Zhur., Biol., 1963, No. 20192. (Translation) Biological Abstracts, Vol. 45, No. 11, Abst. No. 45221. 1964.

Calculations have shown that sewage from a coal-tar chemical plant carried daily into bodies of water about 0.5-6.5 metric tons of suspended matter, 4-11 metric tons of dissolved matter, 4.7-10.5 metric tons of phenols, 0.2 metric tons of ammonia, 5 metric tons of sulfates, 9 metric tons of chlorides, and numerous tar-containing materials. The concentration of phenols in fishery ponds should not exceed the sanitary norm of 0.001 mg/l. Sulfides at a concentration of 2.5 mg/l are toxic to fish. Ammonia salts at concentrations above 5 mg/l, and cyanides at concentrations above 0.05 mg/l, disturb the normal development of aquatic organisms. Ammonia gas in a concentration above 0.1 mg/l is toxic to fish.

7476. Hida, Thomas S., and Robert A. Morris (U. S. Bur. Comm. Fish. Biol. Lab., Honolulu, Hawaii). 1963. PRELIMINARY REPORT ON THE MARQUESAN SARDINE, HARENGULA VITTATA, IN HAWAII. Pac. Sci. 17(4): 431-437. Illus. Map; Biological Abstracts, Vol. 45, No. 11, Abst. No. 45248. 1964.

Eight releases of the Marquesan sardine, totaling about 144,000 individuals, have been made around the island of Oahu (Hawaii) from 1955 through 1959 in the hope that they would become established and sufficiently abundant to increase the tuna baitfish supply. Recoveries of the sardine by skipjack fishermen while seining for the local baitfish, nehu (Stolephorus purpuraceus), have been made from all of the major islands except Niihau and Lanai. It

appears that the sardine has established itself in the regular baiting grounds for nehu and its diet is similar to that of the nehu. The occurrence of young sardines since 1958 indicates that they have spawned successfully, but the species is not yet making any significant contribution as a baitfish. (Authors)

7477. Polyanskii, Yu. I., and I. V. Kulemina. 1963. PARASITES OF YOUNG COD IN THE BARENTS SEA. (O PARAZITOFAUNE MOLODI TRESKI V BARENTSEVOM MORE.) Vest. Leningradsk. Univ. Ser. Biol. 18(15:3): 12-21. Map. (English summ.) Biological Abstracts, Vol. 45, No. 11, Abst. No. 45261. 1964.

A parasitological study was carried out on the fry of the cod (Gadus morhua) (1+ of age) taken from different parts of the Barents Sea. Unlike the adult cod that does not reveal any local differences in its parasitic fauna in the Barents Sea (Poljansky, 1955), the young cod taken from different loci demonstrate some significant distinctions in the species of its parasites as well as in the extent and intensity of parasitic infection. The local distinctions in the parasitic fauna of the young cod are conditioned by the fact that the cod does not migrate very long distances at the age in question. Most remarkable are the differences in the parasitic fauna between the young cod living in the littoral zone and those living in the open sea. The cod from the northern parts of the sea appear to have the poorest fauna of parasites. The present study has shown that parasites can serve as a most keen "biological indicator" of their hosts' ecology. (Authors)

7478. Wolf, Harold (California Dept. Fish and Game, Sacramento), and E. W. Jackson. 1963. HEPATOMAS IN RAINBOW TROUT: DESCRIPTIVE AND EXPERIMENTAL EPIDEMIOLOGY. Science 142(3593): 676-678. Illus.; Biological Abstracts, Vol. 45, No. 11, Abst. No. 45268. 1964.

Four ingredients of a dry diet, Santa Monica, and a special food supplement, were tested for their effects on the occurrence of hepatomas in Salmo gairdneri. When cottonseed meal was omitted from the diet, no hepatomas developed in the experimental fish. When the same diet with its usual cottonseed meal component was fed, 48% of the fish developed hepatomas. (Authors)

7479. Lindall, Arnold W., Jr., G. Eric Bauer, Padmaker K. Dixit, and Arnold Lazarow (Dept. Anat., Univ. Minn., Minneapolis, Minnesota). 1963. ISOLATION OF AN INSULIN SECRETION GRANULE FRACTION. Jour. Cell Biol. 19(2): 317-324. Illus.; Biological Abstracts, Vol. 45, No. 12, Abst. No. 49309. 1964.

Goosefish islets were homogenized in 0.25 M sucrose and separated into nuclear, mitochondrial + secretion granule, microsomal, and supernatant fractions. Eighty percent of the cytochrome oxidase activity and 75 percent of the bioassayed insulin activity were found in the mitochondrial +

secretion granule fraction (6000 g for 10 minutes). The mitochondrial + secretion granule fraction was further subfractionated by centrifugation (2 hours at 100,000 g and 0° C) using a continuous linear density gradient (1.0-2.0 M sucrose). Eighteen to 20 subfractions were collected by piercing the bottom of the tube and collecting drops. The total protein was distributed into a bimodal curve consisting of a high density component, which contained 90 percent of the insulin (secretion granules), and a lower density component, which contained the cytochrome oxidase activity (mitochondria). (Authors)

7480. Wisely, Baughan (Div. Fish and Oceanogr., C.S.I.R.O., Cronulla, New S. Wales, Australia). 1962. STUDIES ON EPHEMEROPTERA. II. COLOBURISCUS HUMERALIS (WALKER); ECOLOGY AND DISTRIBUTION OF THE NYMPHS. Trans. Roy. Soc. New Zealand Zool. 2(25): 209-220. Illus. Maps; Biological Abstracts, Vol. 45, No. 12, Abst. No. 49652. 1964.

The physical conditions and associates of Coloburiscus nymphs in Purau Stream, Banks Peninsula, N. Z., are described. It is suggested that the apparent absence of trout (Salmo trutta) from this habitat is associated with a lack of suitable spawning beds. Streams and a river subjected to periodic flooding and scouring in the Cass Basin, Canterbury, were apparently uninhabited by nymphs. The 4 streams in which nymphs were abundant were "stable"; i. e., not affected greatly by flooding. The probable buffering action of lakes in maintaining these conditions locally is discussed. In the Selwyn River, Canterbury, the abundance of nymphs appeared to vary with the nature of the substratum. Nymphs were not found where flood scouring had produced a hard bed with very few loose stones; but they were abundant where the bed consisted of undisturbed loosely-packed, small stones, provided surface water was present all the year. It is suggested that Coloburiscus nymphs are indicators of stable conditions; and that when an abundance of nymphs is found in a substratum of small, loosely-packed stones, the area is probably suitable for redd making, spawning and the subsequent development of young trout. (Auth.)

7481. Tarr, H. L. A. (Fish. Res. Bd., Technol. Res. Lab., Vancouver, British Columbia, Canada). 1964. INCORPORATION OF RADIOACTIVE PURINE AND PYRIMIDINE BASES AND OF THYMIDINE INTO THE DEOXYRIBONUCLEIC ACID OF SALMON MILTS. Canadian Jour. Biochem. 42(1): 51-57; Biological Abstracts, Vol. 45, No. 12, Abst. No. 50209. 1964.

C¹⁴-labeled adenine, guanine, and cytosine, and tritiated thymidine were incorporated into the deoxyribonucleic acid of salmon milts, either by injection into the milts of live fish or into excised milts. The amount incorporated was very small. Under the experimental conditions radioactive nucleosides, deoxyuridine, adenosine 5'-mono- and tri-phosphates, orotic acid, uracil, ribose 1-phosphate, and ribose 5-phosphate were not incorporated. It is suggested

that these results may be due to the comparative impermeability of the cells to the various compounds. (Auth.)

7482. Huggel, H., A. Kleinhaus, and M. Hamzehpour (Lab. Anat. Physiol. Comp., Univ. Genève, Geneva, Switzerland). 1963. THE BLOOD COMPOSITION OF SALMO GAIRDNERI IRIDEUS AND SQUALIUS CEPHALUS (TELEOSTEI, PISCES). (COMPOSITION DU SANG DE SALMO GAIRDNERI IRIDEUS ET SQUALIUS CEPHALUS.) Rev. Suisse Zool. 70(2): 286-290; Biological Abstracts, Vol. 45, No. 12, Abst. No. 50467. 1964.

7483. Idler, D. R., H. C. Freeman, and B. Truscott (Fish. Res. Bd. Canada, Technol. Res. Lab., Halifax, Nova Scotia, Canada). 1964. STEROID HORMONES IN THE PLASMA OF SPAWNED ATLANTIC SALMON (SALMO SALAR) AND A COMPARISON OF THEIR DETERMINATION BY CHEMICAL AND BIOLOGICAL ASSAY METHODS. Canadian Jour. Biochem. 42(2): 211-218; Biological Abstracts, Vol. 45, No. 12, Abst. No. 50567. 1964.

11-Ketotestosterone, cortisone, and cortisol were isolated and identified as the principal steroid hormones in spawned male Atlantic salmon plasma and the dihydroxyacetone steroids in spawned male and female Atlantic salmon plasma were determined. A large plasma sample from spawned female Atlantic salmon was analyzed for adrenocorticosteroids using both the mouse liver glycogen deposition bioassay and the Porter-Silber chemical method. The results were in agreement and it was thus shown, contrary to a previous suggestion, that the major steroids have the dihydroxyacetone structure in the side chain and there is no indication of large quantities of steroid lacking the hydroxyl group at C-17. (Authors)

7484. Hunn, J. B., and E. P. Reineke (Dept. of Pharmacol., Michigan State Univ., East Lansing). 1964. INFLUENCE OF IODINE INTAKE ON IODINE DISTRIBUTION IN TROUT. Proc. Soc. Exptl. Biol. and Med. 115(1): 91-93; Biological Abstracts, Vol. 45, No. 12, Abst. No. 50698. 1964.

Influence of dietary and/or water level of iodine on the iodine content of rainbow trout plasma and tissues was investigated. The availability of iodine in food and water was differentiated by comparing analyses for trout on two levels of food intake with values for trout fasted for 25-29 days, but held in water containing 10 µg iodine per liter as iodide. Plasma protein-bound iodine (PBI) and total iodine of the lower jaw (thyroid) was determined chemically. Tissue distribution of iodine was determined by an isotope dilution procedure. Iodine levels of plasma and lower jaw were directly related to dietary and/or water levels of iodine. Fasted trout held in iodide-supplemented water had tissue iodine levels comparable to those in sea-run trout. High PBI levels were correlated with high plasma inorganic iodide. Of the tissues examined only the lower jaw concentrated iodine above the

level in the plasma. (Authors)

7485. Brockerhoff, H., M. Yurkowski, R. J. Hoyle, and R. G. Ackman (Fish. Res. Bd. of Canada, Technological Research Lab., Halifax, Nova Scotia). 1964. FATTY ACID DISTRIBUTION IN LIPIDS OF MARINE PLANKTON. Journal of the Fisheries Research Board of Canada, Vol. 21, No. 6, pp. 1379-1384.

In the diatom, *Skeletonema costatum*, as well as in a zooplankton sample, the polyunsaturated fatty acids of the triglycerides were found accumulated in the β -position of the glycerol. This fatty acid distribution pattern is typical for animal fats, in particular for fish oils. Together with the recent demonstration that fish and invertebrates retain in part the structure of ingested triglycerides, the findings of the present study show that the typical structure of marine triglycerides originates in phytoplankton and is to a large degree retained through the marine food chains.

The fatty acid composition of several other lipid fractions of the plankton samples was also determined. (Authors)

7486. McNeil, William J. (U. S. Bur. Comm. Fish. Biol. Lab., Auke Bay, Alaska). 1964. REDD SUPERIMPOSITION AND EGG CAPACITY OF PINK SALMON SPAWNING BEDS. Journal of the Fisheries Research Board of Canada, Vol. 21, No. 6, pp. 1385-1396.

A study of egg recruitment to pink salmon spawning beds in two southeastern Alaska streams (Indian Creek and Harris River) has shown that egg loss during spawning increases as the density of female spawners increases. Mortality was caused for the most part by superimposition of redds.

A mathematical model of spawning success is derived. The model assumes that the curve describing the recruitment of eggs to a spawning bed is asymptotic and that pink salmon females spawning within any defined spawning ground select the sites of their redds at random. The model is used to estimate the asymptotic limit of the egg recruitment curve for a Harris River spawning bed. Levels of mortality associated with various densities of spawning female pink salmon are predicted for Harris River from the model. (Auth. Abst.)

7487. John, Kenneth R. (Franklin and Marshall Coll., Lancaster, Pennsylvania). 1964. ILLUMINATION, VISION, AND SCHOOLING OF *ASTYANAX MEXICANUS* (FILLIPI). Journal of the Fisheries Research Board of Canada, Vol. 21, No. 6, pp. 1453-1473.

The schooling behavior of both light- and dark-adapted *Astyanax mexicanus* (Fillipi) was observed under sudden changes in illumination in the range 10^{-7} to 10^0 ft-c at different times in the diel cycle. In darkness the fish were dispersed, swam slowly, and showed no signs of mutual recognition of one another. There was no simple relationship between the schooling response and the illumination, but in general the frequency, size, and durability of schools

were proportional to the illumination. Schooling was maximal above 10^{-1} ft-c and approached zero at 10^{-6} ft-c. The schooling at any level of illumination varied with the testing procedures. The lowest responses were obtained with a gradual reduction of illumination in the evening. At illumination below 10^{-2} ft-c maximal schooling was obtained from dark-adapted fish. From 10^{-2} ft-c upward, it was obtained from light-adapted fish. The schooling rate (number of fish in a school) reached 100% for a few seconds at 10^{-3} ft-c and for longer periods at higher illumination, but was never sustained at the 100% level throughout any 4-min period. Schooling was generally enhanced by any sudden change in illumination but was never sustained at a high rate under monotonous conditions. The decline with monotony was equated with reduction of the fright situation. The decline with reduced illumination was attributed to the reduction of visual acuity and visibility, and occurred at a greater rate among faster-swimming fish. *Notemigonus crysoleucas* (Mitchill), swimming very slowly, exhibited high schooling rates at 10^{-5} ft-c. Earlier work showed that the retina of *Astyanax* in continuous darkness undergoes a rhythmic diel shift. The behavior showed that this retinal shift is not the classical transformation from scotopic to photopic vision. Dark-adapted during the day, the fish demonstrated rapid visual perception under sudden illumination at any value from 10^{-6} to $10^{-0.69}$ ft-c. Dark-adapted fish at night exhibited increasingly longer light-shock reactions with sudden illumination above 10^{-2} ft-c. According to schooling responses the cone threshold was about 10^{-3} ft-c, and the rod threshold about 10^{-6} ft-c. The mesopic range extended from 10^{-3} to 10^{-2} ft-c. (Auth. Abst.)

7488. Vladikov, Vadim D. (Dept. of Biology, Univ. Ottawa, Ottawa, Ontario, Canada). 1964. QUEST FOR THE TRUE BREEDING AREA OF THE AMERICAN EEL (*ANGUILLA ROSTRATA* LeSUEUR). Journal of the Fisheries Research Board of Canada, Vol. 21, No. 6, pp. 1523-1530.

Johannes Schmidt's outline of the presumed spawning area of *Anguilla anguilla* is analyzed. The author presents evidence that the true spawning place for *A. rostrata* is much further south than the area outlined by Schmidt.

7489. Houston, Arthur Hillier (Dept. of Zoology, Univ. Manitoba, Winnipeg 19, Manitoba, Canada). 1964. ON PASSIVE FEATURES IN THE OSMOREGULATORY ADAPTATION OF ANADROMOUS SALMONIDS TO SEA WATER. Journal of the Fisheries Research Board of Canada, Vol. 21, No. 6, pp. 1535-1538.

Data of various osmoregulatory adaptation studies indicate that many of the changes induced in the body fluid system of the migratory salmonid following entry into sea water are passively self-restrictive.

7490. Black, Edgar C., and Anne R. Connor (Dept.

of Physiology, Univ. British Columbia, Vancouver, B. C., Canada). 1964. EFFECTS OF MS 222 ON GLYCOGEN AND LACTATE LEVELS IN RAINBOW TROUT (*SALMO GAIARDNERI*). Journal of the Fisheries Research Board of Canada, Vol. 21, No. 6, pp. 1539-1541.

The use of MS 222 for sampling during experiments on the glycolytic metabolism of rainbow trout does not effect the results adversely, and might be advantageous to inexperienced workers under difficult field conditions.

7491. Lindsey, C. C., and M. Y. Ali (Inst. of Fisheries and Dept. of Zoology, Univ. of British Columbia, Vancouver, B. C., Canada). 1965. THE EFFECT OF ALTERNATING TEMPERATURE ON VERTEBRAL COUNT IN THE MEDAKA (*ORYZIAS LATIPES*). Canadian Journal of Zoology, Vol. 43, No. 1, pp. 99-104.

Eggs reared at different sustained temperatures ranging from 20° to 24° C produced young with vertebral counts progressively lower at higher temperatures. Eggs transferred from 20° to 30° 2 days after fertilization produced significantly fewer vertebrae, and eggs transferred 6 days after fertilization produced significantly more vertebrae than did those reared at either sustained temperature. Eggs subject to temperatures alternating between 22° and 30° every 12 hours throughout development produced intermediate counts, corresponding to those resulting from sustained rearing at 26°, and showed the highest survival and no abnormalities. (Authors)

7492. Fredin, R. A. (U. S. Bur. Comm. Fish., Seattle, Washington). 1965. SOME METHODS FOR ESTIMATING OCEAN MORTALITY OF PACIFIC SALMON AND APPLICATIONS. Journal of the Fisheries Research Board of Canada, Vol. 22, No. 1, pp. 33-51.

Three methods for estimating oceanic natural mortality rates of Pacific salmon under certain survival conditions are presented. Estimates of ocean mortality rates of Bristol Bay and Karluk sockeye are given. The mortality rate during the year immediately preceding the last 2 months of ocean life of Bristol Bay sockeye that migrated to sea as 3-freshwater fish in 1956 and returned as mature 3-ocean fish in 1959 is estimated to be 28.9%. The average ocean mortality rate during the penultimate year of life of 3-ocean Bristol Bay sockeye is estimated to be 19.5% for the years 1956-57 to 1960-61. The natural mortality rate during the third year of ocean life of 3-freshwater Karluk sockeye is estimated to be 28.2%. Corresponding estimates of average monthly instantaneous mortality rates are 0.028, 0.018, and 0.031, respectively. (Auth. Abst.)

7493. Daykin, P. N. (British Columbia Research Council, Vancouver 8, B. C., Canada). 1965. APPLICATION OF MASS TRANSFER THEORY TO THE PROBLEM OF RESPIRATION OF FISH EGGS. Journal of the Fisheries Research Board of Canada, Vol. 22, No. 1, pp. 159-171.

The concentration of oxygen in the microenvironment of the developing fish egg is always less than the concentration in the supply water. Mass transfer theory is the theoretical tool for understanding the importance of the oxygen content and the velocity of the supply water as factors influencing oxygen uptake of fish eggs. The applicable literature on mass and heat transfer is reviewed and formulas for the calculation of oxygen depletion in the boundary layer surrounding the egg are suggested. Calculated dissolved oxygen requirements for eggs of two fish species at various water velocities are compared with experimentally determined dissolved oxygen requirements. (Auth.)

7494. Mason, J. C. (Dept. of Fisheries and Wildlife, Oregon State Univ., Corvallis), and D. W. Chapman. 1965. SIGNIFICANCE OF EARLY EMERGENCE, ENVIRONMENTAL REARING CAPACITY, AND BEHAVIORAL ECOLOGY OF JUVENILE COHO SALMON IN STREAM CHANNELS. Journal of the Fisheries Research Board of Canada, Vol. 22, No. 1, pp. 173-190.

Coho behavior was examined in two glass-walled stream channels containing riffle-pool series. The apparatus permitted volitional residence. Experimental groups of coho in each channel were permitted to emerge from a simulated redd environment and subsequently studied for 5 months.

Aggressive behavior in these coho fry was initiated within 1 week of emergence from the gravel. Within 10 days of emergence, coho occupied and defended feeding territories well-distributed in riffles. Initial aggression was nipping and chasing but within 2 weeks of emergence, aggression also involved threat.

Pools appear to constitute principal security features of coho environment. A behavioral pattern termed "fright huddle" was observed and described. Individual fish developed habitual living patterns in the channels, and smaller fish tended to occupy downstream areas.

Earliest-emerging coho enjoyed ecological advantages over later-emerging fish. The former were larger at a given time and had a greater tendency to remain in stream channels, suggesting that they have "settler's rights" to available environment and/or better feeding opportunity. The results are discussed with reference to environmental rearing capacity and volitional residence. (Auth. Abst.)

7495. Platford, R. F. (Fish. Res. Bd. of Canada, Atlantic Oceanographic Group, Dartmouth, N. S.). 1965. ACTIVITY COEFFICIENT OF THE MAGNESIUM ION IN SEA WATER. Journal of the Fisheries Research Board of Canada, Vol. 22, No. 1, pp. 113-116.

Sodium hydroxide was added to carbonate-free sea water and the point at which $Mg(OH)_2$ precipitated was detected optically. At this point the hydroxyl ion activity was calculated from the measured pH of the solution and the magnesium ion

activity was calculated from the activity product for $Mg(OH)_2$.

From a knowledge of the magnesium ion activity and other data, it was estimated that about 3% of the total magnesium in the sea water was in the form of $MgSO_4^0$. (Auth. Abst.)

7496. Vladikov, Vadim D. (Dept. Biol., Univ. of Ottawa, Ottawa, Canada), and W. I. Follett. 1965. LAMPETRA RICHARDSONI, A NEW NONPARASITIC SPECIES OF LAMPREY (PETROMYZONIDAE) FROM WESTERN NORTH AMERICA. Journal of the Fisheries Research Board of Canada, Vol. 22, No. 1, pp. 139-158.

A new nonparasitic species of Petromyzonidae, Lampetra richardsoni, the western brook lamprey, from streams of British Columbia, Washington, Oregon, and possibly Alaska, is described and illustrated. This species is distinguished from Lampetra planeri (Bloch), the European brook lamprey (with which it has long been regarded as identical), by dentition, body proportions, pigmentation of the head and tail, and geographical distribution. The description is based on an examination of 275 specimens (69 transformed individuals and 206 ammocoetes). (Auth. Abst.)

7497. Tsuyuki, H., E. Roberts, and W. E. Vanstone (Fish. Res. Bd. of Canada, Technol. Res. Lab., Vancouver, B. C., Canada). 1965. COMPARATIVE ZONE ELECTROPHEROGRAMS OF MUSCLE MYOGENS AND BLOOD HEMOGLOBINS OF MARINE AND FRESH-WATER VERTEBRATES AND THEIR APPLICATION TO BIOCHEMICAL SYSTEMATICS. Journal of the Fisheries Research Board of Canada, Vol. 22, No. 1, pp. 203-213.

The muscle myogens of approximately 50 species of fishes, representing specimens from three (Elasmobranchii, Holocephali, Teleostomi) of the four living classes of fishes of the superclass, Gnathostomata, have been separated by starch gel zone electrophoresis. Evidence is presented for the virtual constancy and species specific nature of these myogen as well as their corresponding multiple hemoglobin patterns. The interspecific and intergeneric similarities of myogen patterns within any one family (Salmonidae as well as Scorpaenidae) were remarkably parallel with the existing morphometric classification. The same degree of relationship was not observed in the corresponding hemoglobin patterns. The usefulness of myogen, and less frequently, hemoglobin patterns for obtaining phylogenetic information as well as for species identification purposes is discussed. (Authors)

7498. Tsuyuki, H., E. Roberts, W. E. Vanstone, and J. R. Markert (Fish. Res. Bd. of Canada, Technol. Res. Lab., Vancouver 8, B. C., Canada). 1965. THE SPECIES SPECIFICITY AND CONSTANCY OF MUSCLE MYOGEN AND HEMOGLOBIN ELECTROPHEROGRAMS OF ONCORHYNCHUS. Journal of the Fisheries Research Board of Canada, Vol. 22, No. 1, pp. 215-217.

Specimens of each of five species of Oncorhynchus

(O. kisutch, O. tshawytscha, O. keta, O. nerka, O. gorbuscha) were analyzed to determine the influence of racial, sexual, physiological, and ecological differences on electrophoretic patterns. O. gorbuscha showed no overall difference in their protein patterns either between or within races. Fully sexually mature O. kisutch of either sex from the Green River hatchery in Washington and from selected locations on the Fraser River were identical to pre-puberal (1-1/2 years) samples from salt water and to sexually maturing adults from the Skeena River system. However, two groups of fall chinooks (O. tshawytscha) sampled at the Green River and Spring Creek hatcheries, and in comparable states of sexual maturity, displayed slight difference in the minor protein zones of their myogen but not in their hemoglobin patterns.

No differences in myogen patterns were observed among samples of 650 adult individuals of O. nerka from 27 racial stocks of the Pacific Northwest, providing convincing evidence that muscle myogen and hemoglobin patterns are essentially invariable species-specific properties of this species.

The results of this study emphasize the usefulness of myogen and hemoglobin patterns for phylogenetic purposes.

7499. Lawler, G. H. (Fish. Res. Bd. of Canada, Biol. Sta., London, Ontario, Canada). 1965. FIN ANOMALIES IN THE WHITE SUCKER, CATOSTOMUS COMMERSONI, POPULATION IN HEMING LAKE, MANITOBA. Journal of the Fisheries Research Board of Canada, Vol. 22, No. 1, pp. 219-220.

7500. Ali, M. A. (Université de Montreal, Montreal, Quebec, Canada). 1965. RETINAL STRUCTURE IN THE ARCTIC CHAR (SALVELINUS ALPINUS L.) Journal of the Fisheries Research Board of Canada, Vol. 22, No. 1, pp. 221-223.

7501. Westrheim, S. J. (Fish. Res. Bd. of Canada, Biol. Sta., Nanaimo, B. C., Canada). 1965. NORTHERN RANGE EXTENSIONS FOR FOUR SPECIES OF ROCKFISH (SEBASTODES GOODEI, S. HELVOMACULATUS, S. RUBRIVINCTUS, AND S. ZACENTRUS) IN THE NORTH PACIFIC OCEAN. Journal of the Fisheries Research Board of Canada, Vol. 22, No. 1, pp. 231-235.

7502. Pitt, T. K. (Fish. Res. Bd. of Canada, Biol. Sta., St. John's, Newfoundland). 1965. MODIFICATION OF THE WHIRLING VESSEL FOR FECUNDITY STUDIES. Journal of the Fisheries Research Board of Canada, Vol. 22, No. 1, pp. 247-251.

7503. Morris, A. W., and J. P. Riley (Dept. of Oceanography, The University, Liverpool, 3, England). 1964. THE DIRECT GRAVIMETRIC DETERMINATION OF THE SALINITY OF SEA WATER. Deep-Sea Research and Oceanographic Abstracts, Vol. 11, No. 6, pp. 899-904.

The direct method of salinity determination devised by Guntz and Kocher has been investigated and refined. The modified method has a coefficient of variation of 0.026%. The salinities obtained with it for a series of 15 sea waters have been compared with those determined by electrical conductivity and by titration. It was found that in general the results were within 0.015%. S of the results obtained by conductivity and titration. (Authors)

7504. Park, Kilho, and Magdalena Catalfomo (Dept. of Oceanography, Oregon State Univ., Corvallis). 1964. GAS CHROMATOGRAPHIC DETERMINATION OF DISSOLVED OXYGEN IN SEA WATER USING ARGON AS CARRIER GAS. Deep-Sea Research and Oceanographic Abstracts, Vol. 11, No. 6, pp. 917-920.

A modification of the gas chromatographic method of Swinnerton, Linnenbom, and Cheek for the determination of dissolved oxygen in sea water is presented. Argon is used as the carrier gas. Relative standard deviation obtained by the modified method is ± 1.4 percent for surface sea water samples. One analysis takes four minutes. (Authors)

7505. Turner, Charles H. (California Dept. Fish and Game, Terminal Island), and Jeremy C. Sexsmith. 1965. MARINE BAITS OF CALIFORNIA. California Dept. Fish and Game, Sacramento, 71 pp.

Information regarding the identification, range, life history, and capture and use of 23 marine baits common to California waters is given. The species discussed include 4 annelids, 6 molluscs, 5 arthropods, 7 fishes, and an alga.

Several fishing habitats: rocky headlands, piers, harbors, open ocean, and back bays, are listed in tabular form with notations as to the appropriate baits, and fishing tackle to use, and the fishes one will most likely catch.

The booklet is illustrated with photographs and line drawings. (C. H. Turner)

7506. Stearns, Franklin (U. S. Bur. Comm. Fish. Biol. Lab., Washington, D. C.). 1964. MONTHLY SEA-SURFACE TEMPERATURE ANOMALY GRAPHS FOR ATLANTIC COAST STATIONS. U. S. Fish and Wildlife Service Special Scientific Report-- Fisheries No. 491, 2 pp., 11 figs.

Anomalies are presented for temperature records from 27 stations located between Maine and Florida. The years 1950-59 are taken as a common base period. The records cover various spans of time since 1873. (Auth. Abst.)

7507. Colton, John B., Jr. (U. S. Bur. Comm. Fish. Biol. Lab., Woods Hole, Massachusetts). 1964. HISTORY OF OCEANOGRAPHY IN THE OFFSHORE WATERS OF THE GULF OF MAINE. U. S. Fish and Wildlife Service Special Scientific Report-- Fisheries No. 496, 18 pp.

Published reports through June 1963 of oceanographic surveys of the offshore waters of the Gulf

of Maine for the period of record through 1960 are summarized. Studies of biology, chemistry, physics, geology, paleontology, ecology, and fishery hydrography are included. Emphasis is given to oceanographic surveys which appear to be least publicized. Summaries are presented in chronological order according to the year of the surveys. A bibliography and subject index of papers referred to in the text are given. (Auth. Abst.)

7508. Rabe, Fred W., and Arden R. Gauvin (Univ. of Utah, Salt Lake City, Utah). 1964. SOME LIMNOLOGICAL EFFECTS OF FERTILIZING THREE CIRQUE LAKES IN THE UINTA MOUNTAINS. Utah Academy Proceedings, Vol. 41, Part II, pp. 255-260.

Limnological data were collected from four alpine lakes in 1960. Effects of adding diammonium phosphate fertilizer to three of the lakes were noted during 1961 and 1962. It could not be predicted whether the phosphates were being utilized because of both high and low readings recorded during the plankton blooms. The decreased water transparencies and high pH values in X-24 and X-49 were not consistent. In 1961 substantial increases in the net plankton (phytoplankton and rotifers) occurred in X-24 and X-49. A marked decrease in these forms was observed in all of the lakes in 1962. Blooms of nannoplankton which appeared in X-24 were believed to be responsible for the decreased net plankton in this lake. Microcrustacean populations exhibited erratic fluctuations during the three years. Lakes X-25 (control) and X-26 showed no significant changes in physical-chemical factors or plankton; however, a succession of phytoplankton forms appeared in X-26 following enrichment. (Authors)

7509. von Bertalanffy, Ludwig (Dept. of Zoology, Univ. of Alberta, Edmonton, Canada). 1964. BASIC CONCEPTS IN QUANTITATIVE BIOLOGY OF METABOLISM. Helgolander Wissenschaftliche Meeresuntersuchungen, Vol. 9, No. 1-4, pp. 5-37.

The theories of open systems, feedback, allometry, and growth are reviewed with respect to their experimental applications.

The models of both open system and feedback apply to a wide range of phenomena in physiology, and represent essential expansion of physical theory. The two conceptions should be clearly distinguished; the feedback model (homeostasis) should not be considered a coverall for physiological regulation in general or identified with "systems theory."

The allometric equation represents the simplest possible relation between body size and metabolic processes. It is of a wide applicability and expresses the harmonization of processes in living systems. However, there is no "surface-" or " $3/4$ -power law" or "law of progressive reduction of metabolic rates." The allometric relationship greatly varies in physiological phenomena.

Variations of the relation between body size and metabolic rate may occur (a) in different tissues or in different species; (b) due to changes

of physiological conditions; (c) due to different experimental designs. Among the conditions altering this relation are such factors as physiological activities, sex, season, previous acclimation, etc.

The size-dependence of total metabolism in mammals is different under basal conditions, in a non-thermoneutral environment, and under conditions of muscular activity. The variations follow Locker's rule, i. e., with an absolute increase of metabolic rate (expressed by the constant b of the allometric equation), regression with respect to body size (expressed by the slope of the allometric line, a) tends to decrease.

The growth equations represent a highly simplified model which, however, covers many phenomena and regularities found in the physiology of metabolism and growth. The parameters occurring in these equations have been verified by physiological experiments in many cases.

In view of the changes of the size-metabolism relation mentioned above, Bertalanffy's so-called "metabolic" and "growth types" should be considered as ideal cases realizable under certain standard conditions, rather than as invariable characteristics of the species or group of species concerned.

Seasonal variations of metabolic rates and growth rates seem to show correspondence.

Urgent problems for further research with respect to each of the basic models are outlined. (Auth. Summ.)

7510. U. S. Bureau of Sport Fisheries & Wildlife (Sandy Hook Marine Lab., Highlands, New Jersey). 1964. TECHNIQUES FOR INFRARED SURVEY OF SEA TEMPERATURE. U. S. Fish and Wildlife Service, Bur. Sport Fish. & Wildl., Bureau Circular No. 202, 142 pp.

Report of workshop held at the U. S. Department of the Interior, Washington, D. C., April 27 and 28, 1964. Includes 13 papers dealing with measurement of sea surface temperatures.

7511. Johnson, James H., Glenn A. Flittner, and Marvin W. Cline (U. S. Bur. Comm. Fish. Biol. Lab., San Diego, California). 1965. AUTOMATIC DATA PROCESSING PROGRAM FOR MARINE SYNOPTIC RADIO WEATHER REPORTS. U. S. Fish and Wildlife Service Special Scientific Report--Fisheries No. 503, 74 pp.

The purposes of this paper are to describe an automatic data processing program (ADP) for summarization of synoptic marine weather reports, to describe the sea temperature reporting program, and to provide information on procedures for calculating the energy exchange at the air-sea interface for the Pacific Ocean.

7512. Kimball, J. F., Jr., and E. J. Ferguson Wood (Inst. of Marine Science, Univ. of Miami, Miami, Florida). 1964. A SIMPLE CENTRIFUGE FOR PHYTOPLANKTON STUDIES. Bulletin of Marine Science of the Gulf and Caribbean, Vol. 14, No. 4, pp. 539-544.

A method of assembling a simple continuous

flow centrifuge for studies on marine phytoplankton is presented together with some data on its performance. (Authors)

7513. Gulland, J. A. (Edited by) (Fisheries Lab., Lowestoft, England). 1964. CONTRIBUTIONS TO SYMPOSIUM, 1963, ON THE MEASUREMENT OF ABUNDANCE OF FISH STOCKS. Rapports et Procès-Verbaux des Réunions, Vol. 155, 223 pp.

This publication consists of 39 papers presented at the Symposium. Major emphasis was on "Catch per Unit Effort", as shown by 28 papers under this general subject. Seven papers concerned surveys on "Eggs, Larvae and Young Fish" and "Echo-Sounders and Photography". The remainder are papers of "Other Methods of Estimating Abundance".

7514. Liebmann, H. and H.-H. Reichenbach-Klinke (Aus der Bayerischen Biologischen Versuchsanstalt (Demoll-Hofer-Institut) München, Germany). 1964. UNTERSUCHUNGEN ZUR EPIDEMIOLOGIE UND ÖKOLOGIE DER FORELLENSEUCHE. Archiv für Fischereiwissenschaft, Vol. XV, No. 2, pp. 94-113.

The Virus-Septicaemia of the trout (trout disease, UNUL) is investigated ecologically.

Two acute and two chronic forms of the disease are distinguished: acute, i. e. lethal, is the hemorrhagic form and the exudate form; chronic is the neuro-vegetative form and dystrophic form. The forms are described.

The acute forms of the disease are highly infectious; with the chronic forms, infections are not immediately possible.

The observations regarding the resistance and immunity lead to the conclusion that a limited immunity may be attained which can, however, easily be "interrupted."

The hexamitae are of primary indicative value as "weakness indicators."

The percentage of liver fat, soluble in ether, of ill and healthy rainbow trout was determined. Despite considering ecologically caused fluctuations, cases of illness with serious inflammations of the organs of the belly cavity showed an increased average fat percentage.

The supply of various vitamin preparations proved the good effect of vitamin combinations, in particular of those with A, B₁₂, and T.

The fat analysis of the liver showed no remarkable differences in the total fat of sound and ill animals.

Whereas treatment with medicines had no striking success, good results could be attained by using stimulants.

Generally speaking, it was proved that up to now no remedy was found for healing the acute cases of disease; but it is possible to restrict the acute stages by means of natural food, thus strengthening the power of resistance.

Practical hints are given to control the development of acute cases. (Authors' Summ.)

7515. International Pacific Salmon Fisheries Commission. 1963. ANNUAL REPORT 1962. International Pacific Salmon Fisheries Commission, New Westminster, Canada; Biological Abstracts, Vol. 45, No. 13, Abst. No. 53621. 1964.

The purpose of the Commission's research program has not varied since its inception in 1937. The report points out that 8 years of research were required to isolate the Hell's Gate obstruction as the principal cause for the continued low level in the abundance of Fraser River sockeye. The elimination of this obstruction by the construction of fishways in 1945 cost one million dollars, yet the benefits from the fishways combined with improved management of the fishery have averaged 8 million annually from 1949 to date and may be expected to be even larger in future years. An exact knowledge of spawning requirements benefits the industry either through increased catches or as a guarantee against reduced catches because of overfishing. The Commission regulates the sockeye and pink salmon fishing by an agreement reached by Canada and the United States in 1930.

7516. Chavin, Walter, and B. N. Bouwman (Wayne State Univ., Detroit, Michigan). 1963. EFFECT OF RADIOIODINE ON THE DEPRESSION OF THYROID IODIDE UPTAKE IN GOLDFISH, CARRASIUS AURATUS L. In: 60th Annual meeting of the American Society of Zoologists, Cleveland, 1963. Amer. Zool. 3(4): 539-540; Biological Abstracts, Vol. 45, No. 13, Abst. No. 54046. 1964.

Abstract only.

7517. Stroganov, N. S., and M. M. Telitchenko. 1958. THE CHRONIC EFFECT OF SMALL DOSES OF U-238 ON BLEAK GONADS. (READ IN NOVEMBER 1957.) (KHONICHESKOE VLIYANIE MALYKH DOZ URANA-238 NA GONADY UKLEEK (AVTOREFERAT DOKLADOV PROCHITANNYKH NOYABRYA 1957 GODA).) Byul. Mosk. Obshch. Ispytat. Prirody. Otd. Biol. 63(4): 154; Referat. Zhur., Biol., 1959, No. 44599. (Translation) Biological Abstracts, Vol. 45, No. 13, Abst. No. 54124. 1964.

Bleaks aged 2 + were kept in 3 liter round crystallizer containing solutions of uranyl nitrate in various concentrations (25, 10, 5, 1, and 0.5 mg-ions of uranium per liter water) and in sedimented tap water. Histological studies of their gonads after 400 days in the above solutions showed that in mature bleaks kept for long time in uranium solutions the ovaries are transformed into testicles, leading to the appearance of intersexes. The possibility of a rapid disappearance of fish in reservoirs contaminated with uranium due to the diminishing of females (they are transformed into males) is stressed. (Courtesy NSF (PL 83-480) 1963.)

7518. Gunning, Gerald E. (Dept. Zool., Tulane Univ., New Orleans, Louisiana). 1963. THE CONCEPTS OF HOME RANGE AND HOMING IN STREAM FISHES. WITH A DISCUSSION OF SENSORY IMPLICATION. In: Animal orientation,

1962. Ergebnisse Biol. 26: 202-215. Illus.; Biological Abstracts, Vol. 45, No. 13, Abst. No. 54164. 1964.

7519. Nelson, Donald R., and Samuel H. Gruber (Inst. Mar. Sci., Univ. Miami, Miami, Florida). 1963. SHARKS. ATTRACTION BY LOW-FREQUENCY SOUNDS. Science 142(3594): 975-977. Illus.; Biological Abstracts, Vol. 45, No. 13, Abst. No. 54197. 1964.

Large sharks (Carcharhinidae, Sphyrnidae), in their natural environment, were attracted to low-frequency (predominantly 20 to 60 cy/sec) pulsed sounds, but apparently not to higher frequency (400 to 600 cy/sec) pulsed sounds, or to low-frequency continuous sounds. The sharks apparently detected and oriented to the sounds in the acoustic far field. (Authors)

7520. Nusenbaum, L. M., and T. I. Faleeva. 1961. A STUDY OF FISH BEHAVIOR IN AN ELECTRIC FIELD. (ISSLEDOVANIE POVEDENIYA RYBY V ELEKTRICHESKOM POLE.) Izvest. Gos. Nauchn.-Issled. Inst. Ozerogo i Rechnogo Rybn. Khoz. 52: 3-93; (English summ.) Biological Abstracts, Vol. 45, No. 13, Abst. No. 54199. 1964.

In connection with investigations on electrofishing, studies were made of the effect of various electric fields on fresh-water fishes (rainbow trout, hybrids of carp and Eastern carp). Fish behavior was studied by direct observation, and also by motion pictures which showed the path traversed by each fish and characteristics of its swimming movements. Data were obtained on field intensity, current density, movement toward the anode, shock, and "body voltage" (potential difference between head and tail) which caused the fish to start when the current was switched on. With a continuous direct current there was a stronger anode response; with a unipolar current impulse, the anode reaction occurred at a lower field intensity. In the field of an electric current the fish moved in a normal manner--by means of sinusoidal bending of the body. The amplitude of vibration of a given part of the body was shown to vary according to the magnitude of the effect. Spinal fishes, mounted in a normal position on floats, were found to react to the field of a continuous direct current only at closing or interruption of the circuit; with both impulse and alternating currents, their movements were normal. Observations were made on the reactions of fishes to increasing and decreasing currents. The nature of the anode reaction is discussed. There are 63 references.

7521. Marshall, N. B. 1963. CHALLENGING PROBLEMS. (VII.) PELAGIC FISHES. In: Marine biology. AIBS Bull. 13(5): 65-67. Illus.; Biological Abstracts, Vol. 45, No. 13, Abst. No. 54282. 1964.

7522. Ferrero, Letizia (Lab. Ctr. Idrobiol.,

Rome, Italy). 1961. PHYSICO-CHEMICAL AND BIOLOGICAL STUDY OF PONTINE SALT LAKES IN RELATION TO THEIR PRODUCTIVITY. II. PAOLA LAKE (SABAUDIA). QUANTITATIVE STUDY OF THE BENTHONIC FAUNA. (RICERCHE FISICO-CHIMICHE E BIOLOGICHE SUI LAGHI SALMASTRI PONTINI IN RELAZIONE ALLA PRODUTTIVITA'. II. IL LAGO DI PAOLA (SABAUDIA). RICERCHE QUANTITATIVE SULLA FAUNA BENTONICA.) Boll. Pesca Piscicolt. e Idrobiol. 16(2): 173-203. Illus. Maps. (recd. 1963.) (French and English summ.) Biological Abstracts, Vol. 45, No. 13, Abst. No. 54301. 1964.

The lake is different from other Pontine coastal lakes because of its size, depth, many inlets, and the form of the bottom. It is supplied by spring waters. The physico-chemical conditions of this environment are relatively stable. The surface layer salinity ranges between 14‰ and 19‰; in recent years, an increase of salinity was observed below a depth of 4 m. The lake may be divided into 2 zones. The southern part is larger and deeper with average depth of 6 m; better circulation permits mussel culture, except during summer. In the northern part the water stagnates at the end of summer with frequent dystrophic blooms of diatoms, dinoflagellates, and *Brachionus*. The prevailing benthonic fauna is represented by *Brachydontes marioni* (65%) and less frequently by Amphipoda, *Corophium insidiosum* and *Gammarus aequicauda* (20%). The average number of individuals is 10,000/m²; average weight 350 g/m²; dry weight of biomass 2.7 kg ha. The average productivity of fishes is approximately 1.7-2 q/ha/year. (Auth.)

7523. Alabaster, John S. (Min. Agric., Fish. and Food, London, England). 1962. THE EFFECT OF HEATED EFFLUENTS ON FISH. In: International Conference on Water Pollution Research, London, 1962. Air and Water Pollution 7(6/7): 541-563. Illus. 1963. Biological Abstracts, Vol. 45, No. 13, Abst. No. 54305. 1964.

The temperature of British rivers, not artificially heated, normally reaches its maximum in July when mean monthly values of 16 to 20° C are usually recorded. The highest temperature recorded between 1953 and 1959 was 24.4° C in the River Medway and between 1908 and 1922 it was 23.5 in the River Wye. Cooling-water may be warmed by 6 to 9° C in passing through condensers in power stations but effluent temperatures may exceed the undisturbed river temperature by more than 9° C when there is recirculation of the cooling-water in the river or, with a mixed cooling system, in towers. Heated effluents, by virtue of their high temperature only, may be lethal to caged trout and coarse fish acclimatized to normal river temperatures during the summer and may also occasionally kill free-living fish which are near effluent outfalls when temperatures increase rapidly. Small free-living fish are mainly affected, larger fish being able apparently to swim away to safety. Usually there is a layer of warm water at the surface of rivers receiving heated effluent, leaving water of

almost normal temperature beneath in which coarse fish can and do live in as great an abundance and variety as elsewhere in the river. Where the temperature of the whole river is above normal because of mixing with a continuous discharge of heated effluent, coarse fish populations may be locally reduced when mean daily temperatures reach 30° C and increased when the water is warmed not more than 26° C. This investigation was undertaken because it was believed that the direct effect of heated effluents might be important in Britain. The work has shown, however, that the chances of fish kills are rare, provided the present operating conditions do not change. The indirect effects of heated effluents on fish in polluted rivers are likely to be important but have not been studied here. (Auth.)

7524. Balabanova, Z. M. 1962. PREVENTION OF WINTER-KILL IN URAL LAKES. (PREDOTVRASHCHENIE ZAMOROV V URAL'SKIKH OZERAKH.) In: Okhrana prirody na Urale. (Conservation of nature in the Urals.) Sverdlovsk. 3. 37-50; Referat. Zhur., Biol., 1963, No. 10162. (Translation) Biological Abstracts, Vol. 45, No. 13, Abst. No. 54308. 1964.

The occurrence of fish mortalities in lakes due to asphyxiation is observed in winter annually, or over a series of years, as a result of sharp reduction or complete disappearance of O₂ from the water. An "O₂ threshold" had been determined experimentally for a series of Ural fishes below which inhibition of respiration sets in: for crucian carp about 1 mg/l O₂, for (pond) carp and tench (*Tinca tinca*) 1-2, for roach and bream 2.0-2.5, for perch and pike 2.5-3.0, for *Coregonus albula ladogensis* hybrids 3.0-3.5 mg/l O₂. The following prophylactic measures are used: control of excessive vegetation and disease, removal of excess silt, ending pollution, mechanical aeration of water during the winter period and opening of ice holes. For the prevention of winter kill under Ural conditions, P. M. Reshetnikova's wind-driven pneumatic aerator should receive wide application, since it is more economical and more effective. Bibliography includes 42 titles.

7525. Barkhanskova, G. M., and L. P. Pavlovskaya. 1962. DATA ON THE FISH FAUNA OF THE LAKES OF THE SOUTHERN KARA-KALPAK REGIONS AND KHORESM OBLAST, AND MEASURES FOR RAISING THEIR PRODUCTIVITY. REPORT 1. (MATERIALY PO IKHTIOFAUNE OZER YUSHNYKH RAIONOV KARAKALPAKII I KHOREZMSKOI OBLASTI I MEROPRIYATIYA PO POVYSHENIYU IKH PRODUKTIVNOSTI. SOOBSHCH. 1.) Vest. Karakalpsk. Fil. Akad. Nauk Uzbeksk. USSR 3.9. 26-33; (Uzbek summ.) Referat. Zhur., Biol., 1963, No. 10163. (Translation) Biological Abstracts, Vol. 45, No. 13, Abst. No. 54309. 1964.

The water-masses of the southern region of Kara-Kalpak are characterized by constant fluctuations of the water levels in relation to the sources of the water supply. With respect to the quantity of the biomass and the composition of the benthic

population, they occupy an intermediate position between water bodies containing an average amount of food and those containing a small amount. The benthic fauna is dominated by tendipedid larvae (73%), rare instances of oligochaetes (9%), larvae of dragonflies (0.8%), of mayflies (7.2%), and of caddisflies (9%). The zooplankton in the summer are represented by 21 species. The fish fauna comprises carp, sheetfish, asp (*Aspius aspius*), roach (*Rutilus rutilus*), goldfish (*Carassius auratus*), and bream (*Abramis brama*). In addition, in Khodzha-Kul' Lake are found perch, mosquitofish, *Gambusia affinis*, *Pelecus cultratus*, *Abramis sapa*, ide (*Leuciscus idus*), rudd (*Scardinius erythrophthalmus*), and pike (*Esox lucius*). The lake is connected with the Amu Darya River. In the lakes of Sokkyl'n system rare occurrences of shovelnose sturgeon, bream, and Aral barbel (*Barbus brachycephalus*) have been recorded. The water bodies of the Khoresm district are characterized by a strong overgrowth and a more or less saline water. Judging from the amount of benthos, these water masses are poor in food. Mortalities due to lack of O_2 are often observed in winter. Cyprinoid fish form the basis of the ichthyofauna.

7526. Bryuzgin, V. L. 1960. METHODS OF SELECTION AND INITIAL HANDLING OF EMPIRICAL MATERIALS FOR STUDYING GROWTH OF FISHES. (K METODIKE SBORA I PERVICHNOI OBRABOTKI EMPIRICHESKIKH MATERIALOV DLYA IZUCHENIYA ROSTA RYB.) Ezhegodnik Nauchn. Rabot. Khersonsk. Gos. Ped. Inst. Estestvoznaniye Kherson 101-105; Referat. Zhur., Biol., 1963, No. 10124. (Translation) Biological Abstracts, Vol. 45, No. 13, Abst. No. 54311. 1964.

For obtaining a uniform sample for the purpose of determining the age and growth rate, it is recommended that, in heavy-scaled fish with a lateral line, 4-5 scales be taken from below the base of the dorsal fin in the first row of the lateral line. This is particularly necessary for the construction of an empirical scale correlating the length of the fish with the radius of the scales. In light-scaled fish the scales can be collected by scraping a strictly delimited area. For the study of specimens of a single population, it is necessary to take samples from a strictly specified site. The method of back calculation of growth rate according to Monastyrsky, Lea, and Lee specifies measurements on scales, bones, and otoliths that are carried out in definite directions. In using empirical scale methods for the calculation of the growth rate, any radius on the fish scale may be selected on the basis of clearness and definiteness of the annual rings.

7527. Burchuladze, O. G., N. G. Gogiberidze, and L. M. Chkhatarashvili. 1962. ON THE CAUSES OF THE DECLINE IN THE ABUNDANCE OF RIPUS (*COREGONUS ALBULA* LADOGENESIS) IN LAKE PARAVANI. (O PRICHINAKH SNIZHENIYA CHISLENNOSTI RIPUSA NA OZ. PARAVANI.) Tr. Nauchn.-Issled. Rybokhoz. Sta. Gruzii. 7: 51-56; Referat. Zhur., Biol., 1963, No. 20187. (Transla-

tion) Biological Abstracts, Vol. 45, No. 13, Abst. No. 54312. 1964.

The decrease in the abundance of Lake Paravani ripus was caused by the fall in the lake level, by the resulting deterioration of overwintering and spawning conditions, by the increase in the number of waste fish which devoured the spawn and larvae of ripus, as well as by inbreeding which produced sterile individuals. The author recommends raising the lake level, intensification of the catch of waste fish, and introduction into the lake of ripus from other bodies of water. Bibliography includes 18 titles.

7528. Dannevig, Gunnar (Statens Biol. Stasjon Flødevigen, Norway). 1963. ARTIFICIAL PROPAGATION OF COD. Fiskeridirekt. Skrifter Ser. Havunders. 13(6): 73-79. Illus.; Biological Abstracts, Vol. 45, No. 13, Abst. No. 54313. 1964.

Tagging experiments have shown clearly that cod populations along the southern coasts of Norway are split into a number of local and quite independent stocks, and there is little or no exchange between the stocks of different fjords, or between the fjords and adjacent waters outside. Cod are fished heavily, and few fish survive to become sexually mature. Eggs have a very high mortality in nature, but 90% hatch in the hatchery at Flødevigen. Liberation of 100 to 150 million larvae in several alternate years in Oslofjord showed these year-classes to become more abundant than those of other years. Therefore, the artificial hatching and release of cod larvae may prove profitable. (R. P. E.)

7529. Filonenko, K. D. 1961. GOSNIORKH PUBLICATIONS FOR THE YEAR 1961. (IZDANIYA GOSNIORKH 1961 GODA.) Nauchn.-Tekh. Byul. Gos. Nauchn.-Issled. Inst. Ozerogo i Rechnogo Rybn. Khoz. 13/14. 135-136; Referat. Zhur., Biol., 1963, No. 10180. (Translation) Biological Abstracts, Vol. 45, No. 13, Abst. No. 54318. 1964.

Volume 50 of Izvestia GosNIORKh describes characteristics of the fish culture of existing reservoirs of the USSR, as well as of reservoirs in the process of construction and those projected for the future, including a classification of reservoirs and methods of determining their fish productivity. In volume 51 methods of fish production and cultivation of fish food are discussed, including methods of marking young commercial fish with radioactive isotopes. Volume 52 is devoted to biological and technical principles of electrofishing. Volume 53, which is now being prepared for publication, will contain a survey of the acclimatization of freshwater fish in the USSR. There will also be articles on the following subjects: physiology, Vol. 54; formation of fish stocks in the Volga reservoirs, Vol. 55; organization of rational fisheries on small lakes, Vol. 56; ways of developing the methods of commercial fishery, Vol. 57; problems associated with the improvement of sanitary conditions of fishery waters and the removal of waste water therefrom, Vol. 58.

7530. Igarashi, Shuzo. 1963. STUDIES ON AIR SCREEN IN WATER. 1. APPLICATION FOR FISHING GEAR. 2. ON INTERCEPTING EFFECT ON FISHES. Bull. Fac. Fish. Hokkaido Univ. 14(1): 23-29. Illus.; (In Japanese with English summ.) Biological Abstracts, Vol. 45, No. 13, Abst. No. 54325. 1964.

An air screen (air bubble curtain and a screen of water jets) was tested as a barrier to the passage of fish in an experimental tank containing 10 goldfish. Decreasing the interval between the air jet holes increased the effectiveness of the air screen as a barrier. (R. S.)

7531. Ivanova-Berg, M. M. 1962. NEW DATA ON THE DISTRIBUTION OF THE SEA LAMPREY. (NOVYE DANNYE O RASPROSTRANENII MORSKOI MINOGI.) Nauchn.-Tekh. Byul. Gos. Nauchn.-Issled. Inst. Ozerного i Rechnogo Rybn. Khoz. 15: 32-34; Referat. Zhur., Biol., 1963, No. 1015. (Translation) Biological Abstracts, Vol. 45, No. 13, Abst. No. 54327. 1964.

Cases of capture of the sea lamprey, Petromyzon marinus, in the estuary of the Luga River and in Neva Bay of the Gulf of Finland are recorded. This is apparently connected with the penetration of Atlantic waters of high salinity through the Denmark Strait into the boundaries of the Baltic Sea. The penetration of the sea lamprey far beyond its normal range of distribution (waters of the Murman coast) is also recorded, a fact which is connected with the increase in temperature of the southern part of the Barents Sea.

7532. Iwaszkiewicz, Michał (Dept. Fish., Coll. Agric., Poznań, Poland). 1962. SEXUAL MATURATION AND FERTILITY OF THE FEMALES OF THE GRAYLING, THYMALLUS THYMALLUS L. FROM THE WEST POMERANIAN RIVERS. Zool. Polon. 12(3): 247-253. (recd. 1963). (Polish and Russian summ.) Biological Abstracts, Vol. 45, No. 13, Abst. No. 54328. 1964.

The material used in this study came from the rivers of the coastal region: Radwia, Wieprz, Parsenta, and from Drawa, a river in the Warta basin. The grayling females attain maturity in the fourth year. This is confirmed by the spawning marks found on the scales. In older individuals these marks indicate that spawning is repeated at yearly intervals. The fecundity was determined by direct counting of oocytes in the gonads (30 specimens), and ranges from 1300 to 7600 eggs. The average relative fertility, in round numbers, for the age-groups 3+, 4+, 5+, is 10,400 eggs. In age-groups 6+ and 7+ a slight decrease can be observed, the number of eggs being on the average 9400. The weight of the mature gonads averages 15% of the total body weight. The diameter of mature eggs is 3.2 mm. Age 4 is the most valuable age group for the grayling population in the rivers of West Pomerania. The discordance of the author's results with those concerning the grayling population in the rivers of southern Poland and Czechoslovakia, and their agreement with the results obtained by

Anderson suggest the existence in Poland of different grayling biotypes. To what extent the above suggestion is right can only be shown by precise investigations into the complex of biological as well as meristic and plastic characters. (Auth.)

7533. Kirpichnikov, V. S. 1961. DETERMINATION OF THE RATE OF STOCKING OF FISH IN THE ACCLIMATIZATION AND STOCKING OF RESERVOIRS. (K VOPROSU OB OPREDELENII NORM POSADKI RYB PRI AKKLIMATIZATSII I ZARYBLENII VODOEMOV.) Izvest. Gos. Nauchn.-Issled. Inst. Ozerного i Rechnogo Rybn. Khoz. 51: 125-136, 270; (English summ.) Referat. Zhur., Biol., 1963, No. 10181. (Translation) Biological Abstracts, Vol. 45, No. 13, Abst. No. 54330. 1964.

In determining the rate of stocking it is necessary to take into consideration the character of the reservoir, the availability of favorable habitats, and the biological characteristics of the species being introduced. Reservoirs are divided into 2 groups: (1) those which have climatic, hydrological and trophic conditions suitable to the life of the stocked object, where it can occupy a vacant ecological niche, and (2) those in which successful acclimatization can be obtained by substituting the stocked species for some other local species. Rates of stocking in reservoirs of the first type can be smaller than those of reservoirs of the second type.

7534. Krykhtin, M. L., and V. Ya. Levanidov. 1962. A FORECAST OF FISH PRODUCTIVITY OF PROJECTED RESERVOIRS ON THE LOWER AMUR RIVER. (PROGNOZ RYBOPRODUKTIVNOSTI PROEKTIRUEMYKH NIZHNEAMURSKIKH VODOKHRANILISHCH.) Izvest. Tikhookeansk. Nauchn.-Issled. Inst. Rybn. Khoz. i Okeanog. 48: 140-156; Referat. Zhur., Biol., 1963, No. 10179. (Translation) Biological Abstracts, Vol. 45, No. 13, Abst. No. 54332. 1964.

A characterization is given of biological features of the fish fauna, food base, and changes which will occur as a result of the regulation of the flow of the Amur. The conditions for the production of fresh-water fish will change significantly. The upper spawning grounds of silver carp (Hypophthalmichthys molitrix), grass carp (Ctenopharyngodon idella) and amur bream (Parabramis pekinensis) will be partly cut off. The regulation of the flow will have a beneficial effect on the development of the food base. In order to obtain the maximum fish productivity, it will be necessary to prohibit taking of fish during the pre-spawning and post-spawning periods; to increase the commercial size of carp, crucian carp, "amur," and others; to construct artificial spawning grounds for carp and crucian carp, using for this purpose hillocks made of fresh grass; to rear artificially Siberian great sturgeon (Huso dauricus) and sturgeon; to introduce Coregonus albula ladogensis, bighead (Aristichthys nobilis) and European bream. Bibliography includes 32 titles.

7535. Kuderskii, L. A. 1962. THE COMMERCIAL SIGNIFICANCE OF PERCH IN THE LAKES OF KARELIA. (O RYBOKHOZYAISTVENNOM ZNACHENII OKUNYA V OZERAKH KARELI.) Nauchn.-Tekh. Byul. Gos. Nauchn.-Issled. Inst. Ozerogo i Rechnogo Rybn. Khoz. 15. 47-50; Referat. Zhur., Biol., 1963, No. 10164. (Translation) Biological Abstracts, Vol. 45, No. 13, Abst. No. 54333, 1964.

Perch, *Perca fluviatilis*, forms 5% of the catches in waters of Karelia. In recent years there was an increase in the abundance of a particularly slow-growing form of perch, owing to the reduction of the catch of perch. Small perch is a typical trash fish; large perch has an adverse effect on the abundance of commercial fish (*Coregonus*, smelt, whitefish, *Stizostedion*), although it is, itself, an object of commercial fishery. It is recommended that the catch of both large and small perch be intensified.

7536. Makkoveeva, I. I., and M. A. Chvankina. 1962. FOOD AND FOOD INTERRELATIONSHIPS OF IMMATURE ROACH AND BREAM IN THE KOSTROMA OUTLET OF GOR'KY RESERVOIR. (PITANIE I PISHCHEVYE VZAIMOOTNOSHENIYA MOLODI PLOTVY I LESHCHA V KOSTROMSKOM RAZLIVE GOR'KOVSKOGO VODOKHRANILISHCHA.) Dokl. na Nauchn. Konf. Yaroslavl'sk. Gos. Ped. Inst. 1(4): 65-69; Referat. Zhur., Biol., 1963, No. 10125. (Translation) Biological Abstracts, Vol. 45, No. 13, Abst. No. 54340. 1964.

A study was made of the nutrition of 102 specimens of roach, *Rutilus rutilus* (20-34 mm in length) and bream, *Abramis brama* (23-32 mm in length), collected in July 1960 in the Kostroma outlet of the Gor'ky reservoir. The main role of the nutrition of the roach was played by Cladocera (*Bosmina*, *Chydorus*, and others) and chironomid larvae (*Cricotopus silvestris*, *Endochironomus tendens*, and *E. dispar*); in some regions Copepoda (*Mesocyclops* and *Microcyclops*) were of substantial significance as food for roach. For the roach 2 diurnal maxima of feeding intensity (morning and evening) were observed; *Leptodora* and *Bosmina* play the main role in the food of bream. Larval chironomids come to play an increasing role in the food of roach and bream in the lower parts of the outlet. The food spectrum of the roach is, on the whole, fairly wide; as many as 44 species of organisms were found in its food, and 21 species of bream. The highest degree of similarity of food composition in roach and bream (84.62%) was observed in the upper part of the outlet; the lowest, in the lower part (61.28%).

7537. Meisner, E. V. 1958. THE WATER REGIME OF RESERVOIRS AND ITS SIGNIFICANCE FOR FISH LIFE. (VODNYI REZHIM VODOKHRANILISHCH I EGO ZNACHENIE DLYA ZHIZNI RYB.) Tr. Vserossiisk. Soveshch. po Biol. Osnovam Rybokhoz. Osvoeniya Vodokhran., Mosk.-Leningradsk. Akad. Nauk SSSR 119-122; Referat. Zhur., Biol., 1963, No. 10176. (Translation) Biological Abstracts, Vol. 45, No. 13, Abst. No. 54343. 1964.

Through hydrochemical and biological studies it was established that fluctuations in the water-level

and in the water-exchange occurring during the technical management of reservoirs exert a significant influence on the O₂ regime, on the development of phyto- and zooplankton and benthos, as well as on the feeding and the growth of fish.

7538. Nikanorov, Yu. I. 1962. ON THE CATCHES OF PIKE IN LAKE SELIGER. (OB ULOVAKH SHCHUKI V OZERE SELIGER.) Nauchn.-Tekh. Byul. Gos. Nauchn.-Issled. Inst. Ozerogo i Rechnogo Rybn. Khoz. 15. 53-54; Referat. Zhur., Biol., 1963, No. 10190. (Translation) Biological Abstracts, Vol. 45, No. 13, Abst. No. 54346. 1964.

As a result of intensive fishing, the supplies of pike sharply declined. Data for the catches of 1960 show that the spawning stock of pike was dominated by younger age groups. In Lake Seliger pike grow slower than in Lakes Il'men and Vel'ie. It feeds mainly on ruffe and perch (46.1 and 23% of their occurrence); to a lesser extent on roach, bream, and white bream (15.3, 15.3, and 7.6% of their occurrence). For increasing the abundance of pike, fish conservation measures and artificial rearing are recommended.

7539. Oliva, Ota (Zool. Ustav Karlovy Univ., Prague, Czechoslovakia). 1960. SOME FURTHER REMARKS ON THE METHODS OF ESTIMATING FISH POPULATIONS. (JESTĚ K METODĚ ODHADU VELIKOSTI RYBI OSADKY.) Vestník Českoslov. Společnosti Zool. 24(2): 105-129. (Russian and English summ.) Biological Abstracts, Vol. 45, No. 13, Abst. No. 54348. 1964.

Since 1951 the fish population in the back water "Poltruba" (surface area 1804 m²) in the flooded area of the river Labe (Central Bohemia) was studied by means of Schnabel's method. All experiments with marking and recovering of fishes were performed from 1951 to 1955; the results obtained in 1951-54 are summarized, those of 1955 are calculated independently from those of previous years. The prolongation of experiments does not correspond to the requirements for no recruitment and no mortality during the time the experiments were carried out. Fishing was prohibited during the experiments; in the summer of 1955 the abnormal high water level caused a movement of fish from the back waters into the neighborhood and the loss of some marked ones. Therefore, the new estimation in 1955 was carried out. All results are summarized in tables, arranged in schemes used by D. H. Thompson as cited in Lagler (see Oliva 1955). The estimate of pike over 30 cm was carried out in 1951-1954 and it is interesting that the population seems to be in equilibrium. The pike were strictly protected, but their number was constant. The results agree well with the actual number of fish found after poisoning (29 pike), estimate after the 2nd haul on August 28, 1955 = 24. The higher value of final estimate (P) after the poisoning (P = 52) can be explained by the higher mortality of marked pike. This may be caused by the cannibalistic tendencies of larger unmarked specimens. Summarized are results of marking

experiments in the years 1952-1954, and in 1955. The higher mortality rate of marked roach is made evident. The estimate of rudd is not correct, because the experiment was extended to 3 periods. Further estimates are also problematic because of a very small number of recaptures. The estimates for *Leucaspis* and *Blicca* are given. The estimate for bream is too high; the number of marked specimens was evidently not growing as presumed. The estimate of small bream was not successful. The bream of this length (10-15 cm) penetrated into the back water "Poltruba" during the high water level in the summer of 1955 and it is evident that the majority of the population was not capturable by net hauls. The actual number of carp found after poisoning is not in agreement with the number of marked carp of 500-4500 gr of weight. Probably one part of the whole amount was lost during the high water and others were stolen. The estimate of tenches is interesting in showing that seining is not a good catch technique for tenches. The estimate of gudgeons was hindered, probably by the higher mortality of marked individuals and also by the small number of recoveries after poisoning, of both marked and unmarked individuals. From the estimate for bleak, it is also evident that the lack of recaptures of marked fish increases during 3 marking periods. A relatively accurate estimate was obtained by the same method used in one season. Difficulties caused by the small size of specimens, by the increased mortality during the marking manipulations and by the presence of carnivorous fishes were observed in experiments on the bitterling. Different results were obtained in the estimate of size of population of the common northern brown bullhead in the years 1953-54 and independently in the year 1955. It is probable that the increase of bullhead in 1955 was caused by the high water. In this example the estimated size P was 566 and the actual number of fish found after the poisoning, 544. The estimate of yearlings of bullhead was not successful. The estimates of popes (*Acerina*) and perch were not so satisfactory for the lack of material and the impossibility of obtaining recoveries. Schnabel's method is very simple and favorable for determining size of fish stock. (Auth.)

7540. Podlesnyi, A. V. 1962. FORECAST OF THE FORMATION OF FISH RESOURCES IN THE KRASNOYARSK RESERVOIR. (PROGNOZ FORMIROVANIYA RYBNIKH RESURSOV KRASNOYARSKOGO VODOKHRANILISHCHA.) Izvest. Krasnoyarsk. Otd. Geog. Obshch. SSSR 2. 47-70; Referat. Zhur., Biol., 1963, No. 10178. (Translation) Biological Abstracts, Vol. 45, No. 13, Abst. No. 54355. 1964.

General character of the fish fauna and its utilization up to the regulation of the flow of the Yenisei River; living conditions of fish in the reservoir, and the character of the regulated formation of the fish stock in the reservoir; a brief commercial-biological characterization of fish stocked in the reservoirs. The Yenisei is inhabited by 28 species and subspecies of landlocked fish. Plankton-

phages are absent. The growth rate of the fish is low. Important commercial fish are dace (*Leuciscus leuciscus*), roach (*Rutilus rutilus*), and perch (*Perca fluviatilis*). It is recommended that the reservoir be stocked with Baikal sturgeon and Baikal omul, *Coregonus autumnalis migratorius*, as well as with the Yenisei peled, Pyasinsk broad whitefish and lake bream.

7541. Privol'nev, T. I. 1962. CHARACTER OF THE SALMON SPAWNING GROUNDS IN THE NARVA RIVER. (KHARAKTER NERESTILISHCH LOSOSYA NA R. NARVE.) Nauchn.-Tekh. Byul. Gos. Nauchn.-Issled. Ozerogo i Rechnogo Rybn. Khoz. 15. 25-26; Referat. Zhur., Biol., 1963, No. 10129. (Translation) Biological Abstracts, Vol. 45, No. 13, Abst. No. 54358. 1964.

After the Narva power plant was put into operation, a study was made of the dried-up river bed. The spawning grounds of salmon and lampreys were formerly in this locality. The river bed at the spawning grounds consists of limestone (slabs from 2 to 5 m²); sand and small pebbles are absent. The speed of the current at the spawning grounds was nearly 1 m/sec. The current carried the eggs under the slabs where they found good aeration conditions.

7542. Shaverdov, R. S., I. O. Beridze, E. P. Dolidze, Sh. N. Ninua, and A. G. Urushadze. 1962. STEPS TOWARD ACCLIMATIZATION OF PINK SALMON (*ONCORHYNCHUS GORBUSCHA*) IN THE BLACK SEA BASIN. (K AKKLIMATIZATSII GORBUSHI V BASSEINE CHERNOGO MORYA.) Tr. Nauchn.-Issled. Rybokhoz. Sta. Gruzii 7. 61-67; Referat. Zhur., Biol., 1963, No. 20105. (Translation) Biological Abstracts, Vol. 45, No. 13, Abst. No. 54368. 1964.

Spawn obtained in the Berezhnyakov Fish Hatchery (Sakhalin Island) and transferred during the eyed-stage to Georgia was incubated on frames. Mortality during the incubation period was 17.4% and was connected with the multilayer distribution of the eggs on the frames. The young were raised in nurseries on spleen, flour, and fish stuffings (10.2 and 82%, respectively). Mortality of larvae was nearly 15%. The young were released into the river at 4, 2, and 0.5 km, respectively, from the river's mouth. The downstream migration proceeded normally; for 2-3 days the young kept to the pre-estuarine area, and thereafter they moved into the sea. Incubation of eggs and rearing of young lasted 4 months, a shorter period of time than that observed in the Far East. Prospects of the work on the acclimatization of pink salmon in the Black Sea are noted.

7543. Shchetinina, L. A. 1961. AGE EVALUATION OF THE COMMERCIAL CATEGORIES OF ATLANTIC SALMON FROM THE PECHORA RIVER. (VOZRASTNAYA OTSENKA SORTOVOGO SOSTAVA SEMGI REKI PECHORY.) Nauchn.-Tekh. Byul. Gos. Nauchn.-Issled. Inst. Ozerogo i Rechnogo Rybn. Khoz. 13/14. 92-96; Referat. Zhur., Biol.,

1963, No. 10122. (Translation) Biological Abstracts, Vol. 45, No. 13, Abst. No. 54369. 1964.

Over a series of years the age composition of Atlantic salmon according to variety was as follows: "small" (up to 3 kg): 1+ years of life in the sea; "average" (3-7 kg): 2+ years of life in the sea; "large" and "choice" (over 7 kg): 3+, 4+ years of life in the sea. In Atlantic salmon of 2+ sea years both weight and length are subject to great variations and the fish belong partly to the "large" and "choice" varieties. The increase, in recent years, in the "average" Atlantic salmon is explained by a decrease in growth rate, with the result that individuals which formerly belonged to the "large" and "choice" varieties now belong to the "average" variety; and also by the increase in the abundance of the Atlantic salmon over a series of years, which has led, possibly, to the disturbance of the age composition of the catches.

7544. Spanovskaya, V. D., and V. A. Grigorash. 1963. SOME CHARACTERISTICS OF THE ICHTHIOFAUNA OF THE SPAS-KLEPIKIV LAKES. (IKHTIOFAUNA SPAS-KLEPIKOVSKIKH OZER I EE OSOBNOSTI.) Tr. Osk. Gos. Zapovedika 5. 27-56; Referat. Zhur., Biol., 1963, No. 20186. (Translation) Biological Abstracts, Vol. 45, No. 13, Abst. No. 54372. 1964.

A description is given of the lakes and the biology of the pike (Esox lucius), ide (Leuciscus idus), roach (Rutilus rutilus), perch (Perca fluviatilis), and crucian carp (Carassius carassius), with special reference to Lake Velikoe. Due to the presence of an ice cover in winter, the lakes become depleted of dissolved O₂; phytoplankton is well developed; the benthos is poor. The lakes serve mainly as spawning and feeding grounds for the young of the species mentioned above. Only crucian carp live permanently in the lakes. Although the growth rate of fingerlings is high, it varies from year to year in relation to the condition of food reserves. Yearlings entering the lake for summer feeding show a slower rate of growth. Perch turn to predation at an early age. In bream (Abramis brama) and perch cannibalism is strongly developed. The lake fisheries were found to be in an unsatisfactory condition.

7545. Tibbo, S. N., R. A. McKenzie, and W. B. Scott (Roy. Ontario Mus., Univ. Toronto, Toronto, Ontario, Canada). 1963. AN OCCURRENCE OF MAKO SHARKS, ISURUS OXYRINCHUS, RAFINISQUE 1810, IN THE CANADIAN ATLANTIC. Jour. Fish. Res. Bd. Canada 20(5): 1353-1354. Illus.; Biological Abstracts, Vol. 45, No. 13, Abst. No. 54380. 1964.

7546. Wikgren, Bo-jungar P. (Abo Acad, Abo, Finland). 1963. A CONTRIBUTION OF THE OCCURRENCE OF PLEROCERCOIDS OF DIPHYLLOBOOTHRIUM LATUM IN FINLAND. Soc. Sci. Fenn. Commentat. Biol. 26(6): 1-10. Illus.; Biological Abstracts, Vol. 45, No. 13, Abst. No. 54391. 1964.

The material was collected from fish of various

species in Finnish lakes of the Joensuu area and from the Kokemaenjoki River at Vammala. Of 13 species investigated, only the pike, burbot, perch, and ruff were found to harbor plerocercoids of D. latum. Some data are given on intensity of infection and distribution of the plerocercoids in different organs and tissues. The frequency of infection was the same magnitude in the 2 areas, 81-99% of pike and burbot, 23-39% of perch, and some 10% of ruff being infected. There was great variation in the distribution in different organs. The problem of the accumulation of plerocercoids in large predatory fish is discussed. (A. K. W.)

7547. Glynn, I. M. (Physiol. Lab., Univ. of Cambridge, Cambridge, England). 1963. "TRANSPORT ADENOSINETRIPHOSPHATASE" IN ELECTRIC ORGAN. THE RELATION BETWEEN ION TRANSPORT AND OXIDATIVE PHOSPHORYLATION. Jour. Physiol. (London) 169(2): 452-465; Biological Abstracts, Vol. 45, No. 13, Abst. No. 54555. 1964.

The "microsomal" fraction of the electric organ of Electrophorus electricus has been found to be very rich in ATP-ase activity. More than 90% of this activity requires the presence of both Na and K, as well as Mg, and is inhibited by ouabain. It, therefore, has the characteristic features of the "transport ATP-ase" of red cells. Sodium lauryl sulphate (0.5 g/100 ml.) completely inhibits the ouabain-sensitive ATP-ase activity but leaves the residual activity unaffected. 2:4-dinitrophenol (1 mM) has no effect on the ATP-ase activity. Oligomycin at a concentration of 3 µg/ml. inhibits about half the activity, and at a concentration of 10 µg/ml. inhibits just under three quarters of the activity. Oligomycin also causes partial inhibition of the active Na extrusion from intact red cells. The effects of a number of reducing and oxidizing agents on the microsomal ATP-ase have been investigated. The reducing agents cause about 20-30% inhibition; hydrogen peroxide (5 mM) causes about 65% inhibition. Partial or complete inhibition of the ATP-ase activity can be obtained with several sulphhydryl reagents. Comparison of the absorption spectrum of the microsomal preparation in the oxidized and in the reduced state shows no trace of cytochromes, flavoproteins, ubiquinone or pyridine nucleotides. It is concluded that (i) the microsomal fraction is rich in "transport ATP-ase"; (ii) there is no convincing evidence that oxidation-reduction reactions are involved, but (iii) the sensitivity to oligomycin may imply that ion transport and oxidative phosphorylation share a common step. (Auth.)

7548. Croston, C. Bradford (W. Fish Nutr. Lab., Cook, Washington). 1964. DIFFERENCES AMONG GROUPS OF SALMON IN THE BLOOD SERUM LEVEL OF ALKALINE PHOSPHATASE. Trans. Amer. Fish. Soc. 93(1): 95-96; Biological Abstracts, Vol. 45, No. 13, Abst. No. 54601. 1964.

The blood sera of over 150 adults of 2 species of Pacific salmon (Oncorhynchus tshawytscha and O. kisutch) were individually analyzed for alkaline

phosphatase levels by a colorimetric method found suitable for fish blood. Statistical analyses of the results showed significant differences between certain groups differentiated by species, sex, and sexual maturity although there were also wide variations in values for individuals within a group. (Auth.)

7549. Gohar, H. A. F., and A. F. A. Latif (Inst. Oceanogr. and Mar. Biol. Sta., Al-Ghardaqa, U. A. R.). 1963. DIGESTIVE PROTEOLYTIC ENZYMES OF SOME SCARID AND LABRID FISHES (FROM THE RED SEA). Publ. Mar. Biol. Sta. Al-Ghardaqa (Red Sea) 12. 3-42. Illus. (Arabic summ.) Biological Abstracts, Vol. 45, No. 13, Abst. No. 54828. 1964.

Trypsin, carboxypeptidase, dipeptidase, and aminopolypeptidase were examined in representative scarid (coralivorous) and labrid (molluscivorous) fishes. Enterokinase is secreted by the duodenum and the intestinal bulb or bulbs in scarid fishes and by the anterior region of the intestine in labrids. Optimum pH of digestive enzymes in the mesenteries, hepatopancreas, intestinal mucosa and intestinal contents varies one from the other. Enzymatic strength of any given region is higher in scarids than in labrids. Mesenteries showed weak tryptic, carboxypeptidase, dipeptidase, and aminopolypeptidase effects. Hepatopancreas is the main site of secretion of trypsin and carboxypeptidase. Besides, it secretes weak dipeptidase and aminopolypeptidase. Intestinal mucosa has strong dipeptidase and aminopolypeptidase and weak trypsin and carboxypeptidase. Intestinal mucosa is the main site of secretion of the first 2 enzymes. Trypsin and carboxypeptidase detected are attributable to secretion by the intestinal mucosa. As compared with the intestinal mucosa, the intestinal contents have a high content of trypsin and carboxypeptidase, but a lower amount of dipeptidase and aminopolypeptidase. The fishes examined differ from mammals in the distribution of the proteolytic enzymes, i. e. trypsin and carboxypeptidase are not restricted to pancreas but are secreted by intestinal mucosa as well. Similarly, dipeptidase and aminopolypeptidase, which are intestinal enzymes, are secreted by the pancreas. Intestinal bulbs of scarids are of little importance in enzyme secretion. Bile is devoid of trypsin and dipeptidase. In the nature and distribution of digestive enzymes, the coralivorous scarids agree reasonably well with the molluscivorous labrids. The somewhat higher enzymatic power, longer intestine and greater mucosal area of scarids seem to be related to the lower nutritive value of their diet. (Authors)

7550. Pequin, L., and A. Serfaty (Fac. Sci., Toulouse, France). 1963. AMMONIA EXCRETION IN A FRESH-WATER TELEOST: CYPRINUS CARPIO L. (L'EXCRETION AMMONIACALE CHEZ UN TELEOSTEEN DULCICOLE: CYPRINUS CARPIO L.) Comp. Biochem. and Physiol. 10(4): 315-324. Illus. (English summ.) Biological Abstracts, Vol. 45, No. 13, Abst. No. 54844. 1964.

Blood ammonia determinations in the carp, Cyprinus carpio, show that the liver plays an essential part in the formation of ammonia. A method of

perfusing the liver and gut is described. This method allows determination of hepatic ammonio-genesis. There is a seasonal variation in blood ammonia concentration which is correlated with the amount of ammoniacal nitrogen eliminated via the gills. L-Asparagine, L-glutamine and some purines are proposed as possible substrates of ammonia formation in vivo. Hydroxylamine will also lead to an increase in ammonia, though a biological explanation is not proposed for this reaction. (Authors)

7551. Houston, A. H. (Univ. Manitoba, Winnipeg, Manitoba, Canada). 1963. OSMOTIC REGULATION IN MIGRATORY SALMON. In: 60th Annual meeting of the American Society of Zoologists, Cleveland, 1963. Amer. Zool. 3(4): 457; Biological Abstracts, Vol. 45, No. 13, Abst. No. 55107. 1964.

Title only.

7552. Chan, Shung-kai (Abbott Lab., Sci. Div., Chicago, Illinois), and Philip P. Cohen. 1964. A COMPARATIVE STUDY OF THE EFFECT OF HYDROCORTISONE INJECTION ON TYROSINE TRANSAMINASE ACTIVITY OF DIFFERENT VERTEBRATES. Arch. Biochem. and Biophys. 104(2): 335-337; Biological Abstracts, Vol. 45, No. 13, Abst. No. 55189. 1964.

Vertebrates above the evolutionary level of amphibians respond to hydrocortisone injections with an increase in liver tyrosine- α -ketoglutarate transaminase (E. C. 2.6.1.5). Animals showing this response include the rat, guinea pig, chick, pigeon, horned toad (Phrynosoma cornatum), and painted turtle (Chrysemys picta). In contrast, vertebrates at the amphibian level or below failed to show this response. Animals failing to show this response include the bull frog (Rana catesbeiana), grass frog (Rana pipiens), marine toad (Bufo marinus), tiger salamander (Ambystoma trigrinum), mud puppy (Necturus), white bass (Roccus chrysops), and black crappie (Promoxis nigromaculatus). (Authors)

7553. Simpson, T. H., R. S. Wright, and S. V. Hunt (Torry Res. Sta., Aberdeen, Scotland). 1963. SEX HORMONES IN FISH. II. THE OESTROGENS OF SCYLIORHINUS CANICULUS. Jour. Endocrinol. 26(4): 499-507; Biological Abstracts, Vol. 45, No. 13, Abst. No. 55251. 1964.

Ovaries of S. caniculus have been found to contain oestradiol 17B (I) and oestrone (II) each in a concentration of ca. 19 μ g/kg. I was identified by chromatography of the free steroid, its formyl and its Fast Black Salt K (FBSK) derivative and by chromic oxide oxidation of the latter to the FBSK derivative of II. II was identified by chromatography as the free steroid, its acetate and its FBSK derivative and by sodium borohydride reduction of the latter to the corresponding FBSK derivative of I. The oocytes contain approximately 80% of the ovarian oestrogens and their oestrogen content increases with oocyte mass. The ratio of I to II in

the oocytes is 1:1 and is $>2:1$ in the ovarian tissue. Free I (ca $3\mu\text{g/l}$) and II (ca. $0.5\mu\text{g/l}$) were also found in female blood plasma. No conjugated or protein bound oestrogens were detected. (Authors)

7554. Kleerekoper, H. (McMaster Univ., Hamilton, Ontario, Canada). 1963. THE RESPONSE TO AMINE "F" (OLFACTORY STIMULUS) BY SIX SPECIES OF MARINE FISH. In: 60th Annual meeting of the American Society of Zoologists, Cleveland, 1963. Amer. Zool. 3(4): 517. 1963. Biological Abstracts, Vol. 45, No. 13, Abst. No. 55459. 1964.

Abstract only.

7555. Aronson, Lester R., and Harriett Kaplan. 1963. FOREBRAIN FUNCTION IN AVOIDANCE CONDITIONING (TILAPIA MACROCEPHALIA). In: 60th Annual meeting of the American Society of Zoologists, Cleveland, 1963. Amer. Zool. 3(4): 483-484. 1963. Biological Abstracts, Vol. 45, No. 13, Abst. No. 55490. 1964.

Abstract only.

7556. Chessick, Richard D. (Vet. Admin. Res. Hosp., Chicago, Illinois), Jean Kronholm, and George Maier. 1963. EFFECT OF LYSERGIC ACID DIETHYLAMIDE (LSD-25) AND OTHER DRUGS ON TROPICAL FISH. Jour. Nerv. and Mental Dis. 137(4): 389-394. Illus.; Biological Abstracts, Vol. 45, No. 13, Abst. No. 55908. 1964.

Thirty species of tropical fish were screened for LSD-25 reactions. Eleven were found to have repeatable behavior changes but none showed all the behavior changes seen in Siamese fighting fish. A common characteristic shown by all reactors was that of surface swimming. Since none of the ten species besides Siamese fighting fish showing consistently repeatable reactions to LSD-25 showed similar reactions to sodium azide or potassium cyanide, and Siamese fighting fish reactions only partially overlap and then only a limited temperature range, it must be concluded that the behavioral changes seen with LSD-25 cannot be accounted for by assuming that LSD-25 acts mainly like a respiratory enzyme poison such as sodium azide or potassium cyanide. Reserpine ($10\mu\text{g/ml}$) was found to be toxic for three species at high temperatures. Serotonin (1 mg/ml), norepinephrine ($50\mu\text{g/ml}$) or reserpine ($10\mu\text{g/ml}$) neither blocked nor potentiated the reaction of LSD-25 ($1\mu\text{g/ml}$) on any of these fish at any temperature. The number of reactions generally declined with temperature from 35°C (95°F) to 15°C (59°F) except for sodium azide, where temperature did not have a profound effect. The optimal temperature in these experiments appeared to be 30°C (86°F) because of the toxicity seen with some drugs at higher temperatures. Biochemical analysis showed that serotonin did enter the fish, and intraperitoneal injection of reserpine produced no changes. (Authors)

7557. Brizinova, P. N. 1958. CHANGES OF FATNESS IN THE ONTOGENESIS OF THE CARP. (IZMENENIE ZHIRNOSTI V ONTOGENEZE KARPA.)

Tr. Soveshch. Ikhtiol. Komis. Akad. Nauk SSSR 8. 244-250; Referat. Zhur., Biol., 1960, No. 35213. (Translation) Biological Abstracts, Vol. 45, No. 13, Abst. No. 56139. 1964.

A study was made on change in fat accumulation in fingerlings of hybrid carp and wild carp from the first day after hatching. A parallel study was made on moisture content in growing fish. The fat content of fingerlings increases with the increase in weight. This can be explained by the lowered rate of metabolic exchange in larger fish and also by preferences in the selection of food. Laboratory studies showed that both the survival rate and the lowering of fat of large fish during hibernation were considerably greater than that of small fish. Fingerlings with 3 - 3.5% of fat are quite fit for hibernation in low temperatures. (Courtesy NSF (PL 83-480) 1963.)

7558. Buznikov, G. A. 1957. THE PHYSIOLOGY OF THE HATCHING GLANDS OF EMBRYOS OF BONY FISH. (K FIZIOLOGII ZHELEZ VYLUPLENIYA EMBRIONOV KOSTISTYKH RYB.) Zhur. Obshchei Biol. 18(5): 350-359; Referat. Zhur., Biol., 1959, No. 51905. (Translation) Biological Abstracts, Vol. 45, No. 13, Abst. No. 56141. 1964.

Removal of egg membranes considerably retards the disappearance and secretion of hatching glands in embryos of various fish. The stimulating function of the membranes is not a result of their mechanical effect on the hatching glands. Removal of the membranes increases the rate of O_2 consumption only prior to the hatching of the larvae. Lowering of partial pressure of O_2 activates the hatching glands and hastens spawning. The rise in the partial pressure of O_2 retards the spawning. The stimulating effect of the membranes on the hatching glands consists, therefore, of the lowering of the O_2 content in the perivitelline space which surrounds the embryo. (Courtesy NSF (PL 83-480) 1963.)

7559. Jasinski, Andrzej (Univ. Kraków, Cracow, Poland). 1962. STRUCTURE AND VASCULARIZATION OF THE PITUITARY BODY OF TELEOSTS. II. THE RAINBOW TROUT (SALMO IRIDEUS GIBB.), PERCH-PIKE (LUCIOPERCA LUCIOPERCA L.), BURBOT (LOTA LOTA L.), AND POND LOACH (MISGURNUS FOSSILIS L.). Acta Biol. Cracoviensia Ser. Zool. 5(1): 67-93. Illus.; Biological Abstracts, Vol. 45, No. 13, Abst. No. 56272. 1964.

The epithelial part of the gland consists of anterior, transitional, and intermediate lobes. Processes from the neural part penetrate the intermediate lobe. Except in Misgurnus, the differences in microscopical structure of the lobes are distinct in all the species investigated. The gland has a blood supply of its own, and none or only few capillary connections to hypothalamus. The network of capillary vessels in the principal lobe (= anterior + transitional lobe) is more dense. The ratio: blood vessel surface area/tissue volume is similar in the

2 parts of the pituitary (1:0.04-1:0.07). The transitional lobe has no blood vessels of its own. (A. P.)

7560. Oliver, A. D. (Entomol. Res. Dept., La. State Univ., Baton Rouge, Louisiana). 1964. CONTROL STUDIES OF THE FOREST TENT CATERPILLAR, MALACOSOMA DISSTRIA, IN LOUISIANA. Jour. Econ. Entomol. 57(1): 157-160; Biological Abstracts, Vol. 45, No. 13, Abst. No. 56715. 1964.

Experiments conducted in Louisiana during 1961-62 indicate that effective control of the forest tent caterpillar, Malacosoma disstria Hübner, can be obtained by applying phosphamidon or Bidrin, 3-hydroxy-N-N-dimethyl-cis-croton-amide dimethyl phosphate, at 1 lb and 1/4 lb per acre, respectively. These insecticides were effective when applied with aircraft or high gallonage ground sprayers. There was no visible effect on crayfish, fish, or other wildlife species. Crayfish and fish fed caterpillars killed by these insecticides showed no apparent effects of poisoning. Both insecticides killed a wide spectrum of insect species though no sustained residual kill of nonphytophagous insects was observed. No phytotoxicity was observed on any plant in the treated area. Sarcophagid flies parasitized about 41% of the mature larvae and pupae in the vicinity of the experimental area in 1961. (Auth.)

7561. Petrushevskii, G. K. 1958. CHANGES IN THE PARASITOFAUNA OF FISH AS A RESULT OF THEIR ACCLIMATIZATION. (IZMENENIE PARAZITOFAUNY RYB PRI IKH AKKLIMATI ATsii.) In: Osnovnye Problemy Parazitologii Ryb. (Basic problems of fish parasitology.) Leningradsk. Gos. Univ.: Leningrad 256-266; Referat. Zhur., Biol., 1959, No. 58362. (Translation) Biological Abstracts, Vol. 45, No. 13, Abst. No. 57675. 1964.

It has been observed that changes take place in the species composition of fish parasites during acclimatization, the most characteristic feature being a decrease in the number of parasitizing species. Monogenetic trematodes are the parasites most resistant to acclimatization changes. Acclimatized fish in their new environment become infected with new parasites, mainly nonspecific, but widely distributed species. Data are given on the parasites of acclimatized fish from 1953 to 1955. (Courtesy NSF (PL 83-480) 1963.)

7562. Thomas, J. D. (Zool. Dept., Univ. Ghana, Legon, Ghana). 1964. STUDIES ON POPULATIONS OF HELMINTH PARASITES IN BROWN TROUT (SALMO TRUTTA L.). Jour. Animal Ecol. 33(1): 83-95. Illus.; Biological Abstracts, Vol. 45, No. 13, Abst. No. 57677. 1964.

Six species of helminths occurring commonly in the trout were considered: Discocotyle sagittata and Phyllodistomum simile, in the gills and urinary bladder, respectively; Dacnitis truttae and Crepidostomum metoecus, chiefly in the pyloric caeca region; and C. farionis and Neoechinorhynchus rutili, mainly in the alimentary canal behind the caeca. There was a tendency for the proportions of N. rutili in the pyloric caeca to decrease with increase

in the age of the host. Certain pairs of helminth species were associated to a greater degree than would be expected by chance alone. These positive associations can be explained on the grounds that the infective stages of these helminths show overlapping distributional patterns. Statistically significant negative correlations occurred between other species of helminths, particularly those frequenting the same region of the alimentary canal. The possible causes for these inverse relationships including interspecific competition for food or space and the action of these parasites in adversely affecting the biochemical environment either directly or through the medium of host reaction are discussed. In most cases, however, there were no negative correlations, thus giving support to the general contention that interspecific competition between animals is rarely encountered in nature. (Author)

7563. Daugherty, Anita E. (California Dept. Fish and Game, Terminal Island). 1964. THE SAND SHARK, CARCHARIAS FEROX (RISso), IN CALIFORNIA. Calif. Fish and Game 50(1): 4-10. Illus.; Biological Abstracts, Vol. 45, No. 13, Abst. No. 57923. 1964.

In November 1962 and January 1963 two sand sharks, Carcharias ferox, were taken off southern California. These are the first records for the eastern Pacific. Others are known from the Mediterranean and adjacent Atlantic, and 2 from Australia. Unique are the needlelike several-pronged teeth, and their arrangement in the jaws. (Auth.)

7564. de Silva, Donald P. 1963. SYSTEMATICS AND LIFE HISTORY OF THE GREAT BARRACUDA, SPHYRAENA BARRACUDA (WALBAUM). Stud. Trop. Oceanog. 1, 1-179. Illus. Maps; Biological Abstracts, Vol. 45, No. 13, Abst. No. 57924. 1964.

The great barracuda, Sphyraena barracuda (Walbaum), family Sphyraenidae, is found in all tropical seas, with the exception of the eastern Pacific. The following nominal species are considered as synonyms of barracuda Walbaum, 1792: picuda Bloch and Schneider, 1801; becunda Lacépède, 1803; barracuda Shaw, 1804; barracuda Cuvier, 1829; commersoni Cuvier, 1829; dussumieri Cuvier, 1829; agam Rüppell, 1835; affinis Rüppell, 1835; nuageuse Liénard, 1843; picuda Poey, 1866; snodgrassi Jenkins, 1901; and akerstromi Whitley, 1947. S. kadenar Montrouzier, 1857, and microps Marshall, 1953, are probably synonyms. Barracuda were collected off Miami, Florida, from Bimini, Bahamas, and specimens from the Danish Oceanographical Expeditions in the western Atlantic were used. Ontogenetic variation in proportional measurements was determined for 171 specimens from 5.5 to 1111 mm standard length. Keys for identification are presented for barracuda, guachancho, picudilla, borealis, and sphyraena. Most males mature at two years and all mature by three years. Some females mature at three years, and

all mature at four. The spawning season is from April until October off southern Florida. Spawning was not observed but probably occurs in the open ocean. The eggs were not identified from plankton tows. Postlarvae were taken far from shore and near the surface, over depth of 200 to 5200 meters. Age analyses were based upon the scale readings of 555 barracuda, back-calculated lengths from scale measurements, and upon modes in the length-frequency distributions of 2707 specimens from southern Florida. It attains 10 to 12 inches at the end of the first winter, and 18 to 22 inches at the end of its second. It reaches an age of at least 14 years. Maximum length is about 6 feet and a weight of more than 100 pounds. The young barracuda drifts inshore in spring, spends its first summer in shallow nursery areas, and moves offshore to somewhat deeper water in late fall. During the second summer it enters the mangrove habitat or the deeper weed beds. In its third year it enters the coral-reef habitat. The barracuda migrates seasonally along both coasts of Florida. Some individuals may drift far out to sea. Young sometimes occur in loose aggregations, but the adults are solitary. Peck order was observed among individuals from 12 to 16 inches long which were confined in a tank. Young feed upon atherinids, gobiids, and clupeids. Tetraodontiform fishes, hemiramphids, and carangids were most commonly taken by the adults. A change from a shallow-water habitat to that of a reef existence is accompanied by a change in food habits. A summary of the 29 attacks reputedly made by barracuda on humans is presented and analyzed. Underwater experiences with barracuda are discussed in relation to the factors which are favorable to an attack. Poisoning in humans who have eaten fresh barracuda is due to a toxin in the flesh and not from bacterial poisoning. In the western Atlantic, poisonings have occurred throughout the year. There seems to be no relation between the attainment of maturity or the spawning cycle and the poisonous nature of barracuda flesh. Some 58 percent of the stomachs of adult barracuda contained fishes which are reputedly toxic, of which 20 percent were tetraodontiform fishes. Evidence is presented for a foodchain origin of the toxin, and mechanisms are discussed for the transmission of the toxin from planktonic and benthic algae to barracuda by way of intermediate organisms. Variations in hydrographic and meteorological features are believed to result in distinct temporal and spatial variation in the toxicity of barracuda as well as other fishes. (Auth.)

7565. Galkin, G. G. 1958. AN ATLAS OF SCALES OF FRESH-WATER BONY FISH. (ATLAS-CHESHUI PRESNOVDNYKH KOSTISTYKH RYB.) Izvest. Vses. Nauchn.-Referat. Zhur., Biol., 1959, No. 30441. (Translation) Biological Abstracts, Vol. 45, No. 13, Abst. No. 57927. 1964.

The atlas contains scales of 155 spp. and sspp. of mainly fresh-water bony fish with indications of the size of the fish and of the scale. General information on the morphology of scales and the scale cover of bony fish and on the form and structural

elements of the scale are given as well as the relative size of the scales. (Courtesy NSF (PL 83-480) 1963.)

7566. Mains, Edward M., and John M. Smith (Washington State Dept. of Fish., General Admin. Bldg., Olympia). 1964. THE DISTRIBUTION, SIZE, TIME AND CURRENT PREFERENCES OF SEAWARD MIGRANT CHINOOK SALMON IN THE COLUMBIA AND SNAKE RIVERS. Washington Dept. of Fish., Fisheries Research Papers, Vol. 2, No. 3, pp. 5-43.

Fyke net sampling was carried out at Byer's Landing on the Columbia River and Central Ferry on the Snake River to determine the distribution, size, time, and current preferences of seaward migrant chinook salmon.

The only major downstream migration of chinook salmon in the Snake River occurred during the spring months. The first spring freshet approaching 70,000 cfs triggered the initial movement of chinook fingerlings in March 1954 and early April 1955. The migrations peaked in mid-April, approximately one month ahead of the maximum daily discharges, and were nearly completed by the end of June. Temperatures during this period ranged between 40° and 60° F.

Substantial numbers of chinook salmon were found to be passing Central Ferry at all hours of the day during the migration. The peak of chinook movement occurred between 3 a.m. and 6 a.m., the hours encompassing dawn, and minimum movement following during the next 6 hours.

During the two annual migrations that were sampled in the Snake River, 5,735 chinook fry and fingerlings were taken. In 1954, 7 percent were fry of the zero age group, measuring from 30 to 35 mm in length and 93 percent were fingerlings of the one-plus age group, measuring between 70 and 150 mm. In 1955 the fry comprised 20 percent of the total and fingerlings 80 percent. The length mode for the fingerlings was between 90 and 105 mm for both years. Fry were present only during the early part of the run and by the end of April catches were composed entirely of fingerlings.

Horizontal distribution studies at Central Ferry indicated that seaward migrant chinook salmon were present in fair numbers across the entire river. However, from 50 to 60 percent of the catch per unit of effort occurred at the stations within 300 feet of the banks while the remaining 40 to 50 percent were taken at the sampling sites over the central portions of the stream. A change in distribution was observed as water levels rose, with the shorelines being favored at low and medium water levels, when most of the chinook were taken, and the center portion of the river being the choice during high water.

No current preference by chinook salmon could be detected for the available velocities between 2.1 and 7.2 fps. The waters near shore were the most attractive areas regardless of velocity.

There were no well defined vertical depth

zones utilized by seaward migrant chinook at Central Ferry. This species used all available depths at the study site favoring slightly a surface zone when two 30-inch depth positions were available. When three depth zones were available, the chinook favored to a small degree the area near the bottom during one year and the center layer during the second year.

Tests were conducted to determine the effect of captured debris on the efficiency of the nets. It was found that by limiting the duration of the hauls, the reduction in efficiency was not a serious factor. Turbidity and night light conditions could not be shown to influence variations in fish movement in the Snake River.

Studies conducted at Byer's Landing on the Columbia River revealed that the seaward migration of chinook salmon occurred between March and July. A total of 1,070 chinook salmon was captured during the sampling in 1955. A peak in April was composed entirely of fry, while peaks in June and July were largely of fingerlings. No factors, such as temperature or discharge, could be significantly correlated with the time of fry movement. The fry evidently emerged from the gravel and started downstream immediately. In early June, the first major increase in discharge initiated the migration of fingerlings. Water temperatures during the migration ranged between 40° and 60° F.

Seaward migrant chinook passed Byer's Landing at all hours of the day, but the heaviest movement occurred between dusk and dawn. Over 70 percent of the catch per unit of effort was made between 6 p.m. and 6 a.m.

Length and age composition of the Columbia River catch was different from that in the Snake River. Approximately 76 percent of the chinook were fry of the zero age group, ranging between 20 and 55 mm in total length and with a mode between 40 and 45 mm. The remaining 24 percent of the catch were fingerlings of the one-plus age group with a modal length between 85 and 90 mm, 10 to 15 mm smaller than Snake River chinook fingerlings.

The horizontal distribution of chinook salmon on the Columbia was similar to that exhibited at Central Ferry. The stations closest to the banks accounted for the heaviest catches per unit of effort although numerous fish were taken at all stations across the river. Similar to Central Ferry, from 50 to 60 percent of the catch per unit of effort occurred at the stations within several hundred feet of the banks, while the remaining 40 to 50 percent were distributed across the remainder of the river.

In contrast to the results obtained on the Snake River, seaward migrant chinook in the Columbia River exhibited a strong preference for the surface zone. The area within 30 inches of the surfacetook 43.6 percent of the catch per unit of effort, while the mid-depth accounted for 27.5 percent, and the bottom zone for 28.9 percent.

While some differences are discernible between the Snake and Columbia, chinook were present in considerable numbers over the entire breadth and depth of the stream with an overall preference being

shown for the surface layers and the waters near the shorelines. It is apparent, then, that if guidelines are to be practical, they will necessarily have to operate effectively over the entire depth and breadth of these rivers for 24 hours a day during a migration season that lasts from March through July. Such equipment would have to be designed to accommodate chinook salmon from 20 to 160 mm in length. (Authors)

7567. Casey, John G. (Sandy Hook Marine Lab., Highlands, New Jersey). 1964. ANGLERS' GUIDE TO SHARKS OF THE NORTHEASTERN UNITED STATES, MAINE TO CHESAPEAKE BAY. U. S. Fish and Wildlife Service, Bur. Sport Fish. and Wildl., Circular 179, 32 pp.

This guide gives identifying characteristics of sharks and information on the habits and range of the various species found along the North Atlantic coast.

7568. Lasater, J. E., and Frank Haw (Washington State Dept. of Fish., General Admin. Bldg., Olympia). 1964. THE RELATIONSHIP OF AGE TO LENGTH IN PUGET SOUND RESIDENT CHINOOK SALMON. Washington Dept. of Fish., Fisheries Research Papers, Vol. 2, No. 3, pp. 44-50.

Puget Sound chinook salmon were divided into age groups by length from inspection of length-frequency and length-weight frequency plots. Comparison with an earlier age analysis using scale reading showed an 87.2 percent agreement in aging individual fish and 92.2 percent agreement in separating chinook into age groups.

A sample of 100 chinook salmon were aged from scales by three experienced scale readers and from length alone. Aging by length agreed with the scale readings of the individual scale readers nearly as well as they agreed with each other.

The scales of 51 double fin marked chinook believed to be of the 1956 brood were read and the fish were also aged from length. Both methods agreed with the hypothesis that the great majority of the salmon were of the 1956 brood.

Aging of Puget Sound resident chinook salmon from length is as accurate as aging by scale reading, requires less experience, and is less time-consuming. (Authors)

7569. Ryder, R. A. (Ontario Dept. of Lands and Forests, Research Br., Maple, Ontario, Canada), W. B. Scott, and E. J. Crossman. 1964. FISHES OF NORTHERN ONTARIO, NORTH OF THE ALBANY RIVER. Life Sciences, Royal Ontario Mus., Univ. of Toronto, Contribution 60, 30 pp.

Gives an annotated list of species of the Patricia Portion of the Kenora District in northern Ontario. This work increases the total species recorded to 43, plus 1 hybrid and 2 exotics. The ranges of many species were extended considerably from those previously published.

7570. Taylor, W. Rowland (Dept. Oceanography and The Chesapeake Bay Inst., The Johns Hopkins

Univ., Baltimore, Maryland). 1964. LIGHT AND PHOTOSYNTHESIS IN INTERTIDAL BENTHIC DIATOMS. *Helgoländer Wissenschaftliche Meeresuntersuchungen*, Vol. 10, No. 1-4, pp. 29-37.

The rate of photosynthesis at varying amounts of natural sunlight has been measured for large pennate littoral diatoms which inhabit the sand flats of Barnstable Harbor, Massachusetts, and which exhibit vertical migration to the surface at low tide.

The algae require only 12 gm cal/cm²/hr to reach their maximum photosynthetic capacity.

Full midday summer sunlight (75 gm cal/cm²/hr) results in only a 10% inhibition of maximum photosynthesis.

Measurements of light penetration through the sand in which the diatoms are found indicated 10% of solar radiation reaches 1.5 mm.

At noon on a cloudless midsummer day these species existing as deep as 3.0 mm are probably above their compensation level, while those from 2.0 mm to the surface are able to photosynthesize at 90% or better of their maximum rate.

The photosynthetic efficiency at low light levels enables these diatoms to fix considerable carbon, even when the flats are exposed when the sun angle is low.

The migration pattern of these diatoms does not result in significant inhibition of photosynthesis, but rather their photosynthetic apparatus is well adapted to such migratory activity. (Auth. Summ.)

7571. Fischer, Hermann (Botanisches Institut der Universität Bonn, Bonn, Germany). 1964. RESPONSES AND RESISTANCE OF MARINE DIATOMS TO CHANGES IN SALINITY. (VERHALTEN UND RESISTENZ MARINER DIATOMEEN GEGENÜBER VERÄNDERUNGEN DER SALZKONZENTRATION.) *Helgoländer Wissenschaftliche Meeresuntersuchungen*, Vol. 10, No. 1-4, pp. 64-72.

Diatoms of littoral regions are often exposed to considerable salinity fluctuations. This fact suggests that these unicellular organisms exhibit osmotic resistances similar to those found in larger multicellular algae. The responses of typical representatives of the littoral diatom flora were studied after transfer into diluted or concentrated sea water. The technique applied made it possible to compare the results with corresponding data from literature obtained on green, brown, and red algae of the tidal zone. The total amount of resistance of the diatoms studied may reach the values obtained on these multicellular algae or may be lower. The results imply the presence of mechanisms capable of flexible osmotic adjustments to salinity changes. In addition to their osmotic resistance *sensu strictu*, protection from the ill effects of extreme salinities may be of importance, for example, through the formation of jelly, variations in population density and perhaps the ability to migrate into more suitable conditions. All species tested have shown an ability for osmoregulation or for passively tolerating changes in internal osmotic concentration. Some may tolerate plasmolysis even for prolonged periods. Diatoms exhibiting

quantitative and qualitative differences in osmotic resistance may occur in the same microhabitat. (Auth. Abst.)

7572. den Hartog, Cornelis (Rijksherbarium, Leiden, Niederlande). 1964. TYPOLOGY OF BRACKISH WATER. (TYPOLOGIE DES BRACK-WASSERS.) *Helgoländer Wissenschaftliche Meeresuntersuchungen*, Vol. 10, No. 1-4, pp. 377-390.

The Venice System for classification of brackish waters is based on one single factor - salinity - and, consequently, is not fit for a biological classification. The system was amended by defining the different subdivisions according to their biological features (den Hartog 1960). It appears that the transition area between fresh- and sea-water usually shows a tripartition. In the different types of brackish water this tripartition is caused by different factors connected with salinity. In the estuaries the enormous daily salinity fluctuations exercise a too great pressure on the osmotic capacity of many species and, thus, form an effective barrier for them. In the Baltic Sea, where the salinity conditions are more or less stable, the salinity limit for many species is also the limit of their salinity tolerance. In lagoons and isolated brackish waters, the minimum and maximum salinities are decisive for the absence or presence of several species. Although in all these waters the subdivision in an oligohaline, a mesohaline and a polyhaline subtype is evident, there is no reason to suppose that the ranges of the corresponding subtypes will coincide, the more so as their boundaries are determined by different environmental factors. In this paper, therefore, a typological system for the brackish waters is proposed, based on the continuity or discontinuity of the transition between fresh- and sea-water, and on the periodicity of the salinity fluctuations. In some of the eight recognized types, a subdivision according to the amended Venice System is possible. (Auth. Abst.)

7573. Power, E. A., and C. H. Lyles (U. S. Bur. Comm. Fish., Washington, D. C.). 1964. FISHERY STATISTICS OF THE UNITED STATES - 1962. U. S. Fish and Wildlife Service, Statistical Digest No. 56, 466 pp. Avail.: Supt. Documents, U. S. Government Printing Office, Washington, D. C. (\$2.25).

A review of the fishery statistics for the year 1962 collected by the Branch of Statistics, Division of Resource Development. Included are data on the volume and value of the catch of fishery products, employment in the fisheries, quantity of gear operated, number of fishing craft employed, and information on the volume and value of the production of manufactured fishery products and by-products.

7574. Nahhas, F. M., and E. C. Powell (Depts. Biological Sciences, Univ. of the Pacific, Stockton, California, and Florida State Univ., Tallahassee).

1965. MONORCHIIDAE (TREMATODA) FROM FISHES OF APALACHEE BAY, GULF OF MEXICO. The Journal of Parasitology, Vol. 51, No. 1, pp. 16-20.

Five species of monorchiid trematodes, including two new ones, Diplomonorchis floridensis from Symphurus plagiosa (L.) and Pseudohurleytrema shorti from Selene vomer (L.), are reported. The status of the hurleytrematine genera with a single testis is discussed. Parahurleytrema, a new genus characterized by a bipartite seminal vesicle and terminal organ, is created for P. trachinoti (Thomas, 1959) n. comb. (syn. Hurleytrema trachinoti Thomas) and P. coronatum (Manter and Pritchard, 1961) n. comb. (syn. Hurleytrema coronatum Manter and Pritchard). The genus, Pseudohurleytrema Manter, 1942, characterized by a single seminal vesicle and bipartite terminal organ, includes P. eucinostomi Manter, 1942, P. shorti (this paper), and P. malabonensis (Velasquez, 1961) n. comb. (syn. Hurleytrema malabonensis Velasquez). The similarity of the monorchiid fauna of Beaufort, North Carolina, and the northern Gulf of Mexico is discussed. (Authors)

7575. Ferguson, Denzel E., Dudley D. Culley, William D. Cotton, and Ross P. Dodds (Dept. of Zool., Mississippi State Univ., State College). 1964. RESISTANCE TO CHLORINATED HYDRO-CARBON INSECTICIDES IN THREE SPECIES OF FRESH-WATER FISH. BioScience, Vol. 14, No. 11, pp. 43-44.

Tolerances of Mississippi Delta golden shiners (Notemigonus crysoleucas), bluegill sunfish (Lepomis macrochirus), and green sunfish (Lepomis cyanellus) were determined to five chlorinated hydrocarbon insecticides representing three major groups: DDT; toxaphene (a chlorinated camphene); aldrin, dieldrin, and endrin (cyclodiene derivatives). Delta fish were obtained from Twin Bayou near Indianola, Sunflower County, Miss. The bayou, an abandoned stream meander, is bordered for several miles by large cotton plantations and is subject to insecticide contamination by run-off, drift, and possibly some direct application.

Twin Bayou fish are resistant to all test insecticides except DDT. The striking resistance to endrin produces a situation completely contrary to expectations, wherein resistant populations are considerably more susceptible to DDT than to endrin. An approximately 10-fold resistance exhibited by Delta mosquitofish, including those from Twin Bayou, is absent in the three species considered here.

The difference between no mortality and complete mortality represents a very narrow range of concentrations for nonresistant fish.

7576. Barrett, Izadore, and Anne Robertson Connor. 1964. MUSCLE GLYCOGEN AND BLOOD LACTATE IN YELLOWFIN TUNA, THUNNUS ALBACARES, AND SKIPJACK, KATSUWONUS PELAMIS, FOLLOWING CAPTURE AND TAGGING. Inter-American Tropical Tuna Commission, Bulletin IX, No. 4, pp. 219-268.

The general pattern of changes in blood lactate levels in both species following handling and tagging was the same as that reported in the previous study. The peak level of lactate occurred approximately 3/4 of an hour after a remarkably short period of stimulation (less than 16 seconds); recovery was rapid and paralleled that seen in the previous year. However, the peak lactate levels noted in the current experiments were lower, and the recovery levels were slightly higher than those in 1961. For the first time a significant difference in lactate level between untagged and tagged fish was observed in yellowfin during the early stages of recovery. The lactate response to exercise in tunas was again noted to be more rapid than that reported in salmonids. The greater lactate response in skipjack than in yellowfin, which was noted in the previous experiments, was also confirmed.

Higher levels of lactate in skipjack were found to be related to higher initial levels of the precursor, muscle glycogen. The initial levels of glycogen in both yellowfin and skipjack were higher than those reported for many other species of fish. The high glycogen content of tuna muscle may be of significance in relation to the normally high level of activity of these fish, although other sources of energy may also be important. Following handling and tagging, the initial levels of glycogen dropped rapidly in both species during the period in which lactate was accumulating in the blood. Resynthesis of glycogen began within at least 15 minutes in yellowfin and 30 minutes in skipjack. At two hours recovery, the glycogen level was significantly higher in untagged than in tagged yellowfin although no differences between untagged and tagged skipjack were noted. Glycogen levels in both species were higher during the latter part of recovery than at initial capture.

Several differences which were observed between the results of the present experiments and those of the previous year are attributable to colder water temperatures. By comparison, the present experiments indicate that the response of yellowfin to handling and tagging, while submaximal, is nevertheless greater than that due to handling alone. Thus, in yellowfin at least, a high degree of speed and skill in tagging in colder waters may minimize the adverse physiological effects of the procedure, and contribute to increased tag returns. (From Authors' Summ. and Concl.)

7577. Henry, Kenneth A. (U. S. Bur. Comm. Fish., Beaufort, North Carolina). 1964. OREGON COASTAL SALMON AND STEELHEAD TAGGING PROGRAMS. PART I. TILLAMOOK BAY, 1953. Fish Commission of Oregon, Portland, Contribution No. 28, pp. 5-41.

In a tagging program conducted on Tillamook Bay in 1953, 491 fall chinook salmon, 255 silver salmon, 325 chum salmon, and 62 steelhead trout were captured by gill nets and tagged.

There was no significant difference in the number of tagged fish recovered from any tagging area for the four species.

A nonsignificant chi-square value was obtained for tag recoveries of chinook salmon, silver salmon, and steelhead when analyzed according to whether they had moved "up" or "down" the bay after being tagged. A significant value was obtained for a similar analysis of chum salmon tag recoveries, primarily due to the fact that a comparatively large number of recoveries came from chums tagged in the lowest area of the bay which could only be caught by showing no migration or moving "up."

Average elapsed time before recapture in the commercial fishery was 4.7 days for chinook salmon, 5.1 days for silver salmon, 0.9 days for chum salmon, and 2.9 days for steelhead.

For chinook salmon, silver salmon, and steelhead, there was no consistent trend to indicate that fish tagged nearer the spawning grounds were available for a shorter time than fish tagged in the lower bay. Chum salmon tagged in the lower bay did appear to be available to the fishery for a longer period than those tagged in the upper bay.

Based on elapsed time between tagging and recovery, chinook salmon moved slowly through the fishing area during September and early October and more rapidly from mid-October to the end of the season. Silver salmon migrated slowly through the fishing area in September, slightly faster in October, and rapidly near the end of the season. Chum salmon moved slowly through the fishery during early November, fairly rapidly until November 21, and slowed again near the end of the season.

No significant difference could be demonstrated between the number of tags recovered from the three apparent condition groups (good, fair, poor) at time of tagging.

Commercial landings were sampled for average weight, tags, and tag scars. During the fishing season the following proportion of the different species were examined for tags: 5,589 chinook salmon or 89 percent of the total catch; 5,950 silver salmon or 88 percent; 16,437 chum salmon or 75 percent; and 2,589 steelhead or 74 percent.

Date of tagging did not appear to have a significant effect on whether or not the fish were recovered for chinook and silver salmon and steelhead. It did appear to affect chum salmon recoveries, but this was probably because many of these fish were tagged in the lower bay.

Sport fishermen caught 9 tagged chinook salmon, 5 tagged silver salmon, and 1 tagged steelhead. The spawning grounds were not intensively surveyed.

Three tagged chinook were recovered from the Nehalem River and one from the Alsea. Five tagged silvers were recovered from the Nehalem River and one in the ocean near the Columbia River. One tagged chum salmon was recovered in the Columbia River.

Schaefer's (1951b) formulae were used to calculate fish populations available to the commercial fishery: 15,512 chinook salmon for the period September 6 to November 14, inclusive; 21,747 silver salmon for the period August 23 to November 21; 54,308 chum salmon for the period November 1 to December 5; and 7,616 steelhead for the period

November 15 to December 10.

$$\text{The equation } N = \frac{(n+1)(t+1)}{(s+1)} - 1 \text{ was also}$$

used to calculate fish populations available during the designated periods. Populations based on this formula and their 95 percent confidence limits were calculated to be: chinook salmon, 15,341 and 13,042-17,936; silver salmon, 22,495 and 17,420-28,985; chum salmon, 53,747 and 43,383-66,450; and steelhead, 8,709 and 4,660-16,310.

Assuming that the actual populations available to the Tillamook Bay commercial fishery during the designated periods were about 15,500 chinook salmon, 22,000 silver salmon, 54,000 chum salmon, and 8,000 steelhead, then 36 percent of the chinook salmon, 29 percent of the silver salmon, 39 percent of the chum salmon, and 39 percent of the steelhead were caught by the commercial fishery during the designated periods. (Auth. Summ.)

7578. Morgan, Alfred R. 1964. OREGON COASTAL SALMON AND STEELHEAD TAGGING PROGRAMS. PART II. SILETZ RIVER, 1954. Fish Commission of Oregon, Portland, Contribution No. 28, pp. 43-62.

During a tagging study conducted in 1954 on salmon and steelhead migrating into the Siletz River, 194 chinook salmon, 445 silver salmon, 58 chum salmon, and 63 steelhead trout were tagged. The commercial catch was sampled intensively for tagged fish; tags were recovered from 25 chinook, 28 silvers, and 1 chum salmon. The sport catch was not sampled but, by using the tagged-to-untagged ratio from samples of the commercial catch, it was calculated that the sport fishery took between 3 and 7 tagged chinook and between 15 and 32 tagged silvers although only 7 tags were actually returned by sport fishermen. The Siletz Indian Tribe total catch was estimated at 40 chinook and 160 silver salmon. Nothing is known about the chum salmon or steelhead catch by the Indians. Some chinook and silver salmon and steelhead moved at least 3 to 4 miles up the Siletz River, then returned downstream to enter lower tributaries to spawn. Voluntary returns were made of 4 tagged silvers that left the Siletz River and entered other drainages to spawn. The tagged-to-untagged ratios of chinook found dead on the spawning grounds in Drift Creek indicated that chinook destined for Drift Creek received more tags than chinook going to other tributaries. Samples of silver salmon from Drift Creek spawning grounds were too few to be compared to other parts of the Siletz drainage. Only 1 tagged chum salmon and no tagged steelhead were recovered from spawning ground surveys. Several estimates were made of the chinook and silver salmon population. The best estimate of the chinook population was 4,700 fish, using data obtained from the commercial fishery. The upper and lower 95 percent confidence limits for this estimate were 8,200 and 3,500 fish, respectively. The best estimate of the silver salmon population, obtained from tags

recovered in the commercial fishery, was 15,200 fish with confidence limits of 28,100 and 12,700 fish. Insufficient data were available for estimating chum salmon or steelhead populations. It was calculated that the commercial fishery took 36 percent of the chinook and about 12 percent of the silvers that entered the Siletz River in 1954. The combined sport and Indian fisheries took an additional 4 and 10 percent, respectively. The total harvest by all gear amounted to 40 percent of the chinook and 22 percent of the silvers. (Auth. Summ.)

7579. Kitamikado, Manabu, Tatsuo Morishita, and Shinko Tachino (Fac. Fish. Pref. Univ., Mie, Japan). 1964. DIGESTIBILITY OF DIETARY PROTEIN IN RAINBOW TROUT. I. DIGESTIBILITY OF SEVERAL DIETARY PROTEINS. Bulletin of the Japanese Society of Scientific Fisheries, Vol. 30, No. 1, pp. 46-49.

The digestibility of several dietary proteins in rainbow trout was determined by the indirect method using chromium oxide as an indicator. The diets used and their chemical compositions are presented. The proteins of raw meats, such as frozen fish, beef liver, and spleen, showed the highest values, 91-97 percent, in digestibility among the proteins tested. Following these proteins, those of white fish meal, a commercial diet for rainbow trout culture, and dried silkworm pupa showed about 80 percent in digestibility. Soybean meal, a fish meal, and the other commercial meal diets tested were more inferior in the digestibility of protein, about 70 percent or less. The removal of the fatty component from dried silkworm pupa by ether extraction had little influence on the digestibility of the protein. (Authors)

7580. Kitamikado, Manabu, Tatsuo Morishita, and Shinko Tachino (Fac. Fish. Pref. Univ., Mie, Japan). 1964. DIGESTIBILITY OF DIETARY PROTEIN IN RAINBOW TROUT. II. EFFECT OF STARCH AND OIL CONTENTS IN DIETS, AND SIZE OF FISH. Bulletin of the Japanese Society of Scientific Fisheries, Vol. 30, No. 1, pp. 50-54.

The digestibility of protein in the diets containing various levels of starch or oil was determined by rainbow trout. The results of this investigation showed that the digestibility of protein decreased with the increase of starch content in diet, whereas the change of oil content in diet had little influence on the digestibility. On the other hand, the digestibilities of dietary protein in various growth stages of rainbow trout were studied. Through the later stages (from about 10 g to 100 g body weight) there was no significant difference in the digestibility of protein, but in early stages (less than about 6 g body weight) the digestibility showed considerably lower values than those shown in the later stages. In the early stages, the extremely poor digestibility on the protein of white fish meal was conspicuous among the dietary proteins tested. However, the digestibility on the protein of white fish meal was improved appreciably by using the portion of the meal passed through a fine sieve. (Authors)

7581. Johnson, Fritz (Div. of Game and Fish, Minnesota Dept. of Cons., 301 Centennial Bldg., St. Paul). 1963. THE STATUS OF THE SMELT, *OSMERUS MORDAX* (MITCHILL), AND NATIVE FISH POPULATIONS IN KENNEDY LAKE, ITASCA COUNTY, FOUR YEARS AFTER THE FIRST APPEARANCE OF SMELT. Minnesota Dept. of Cons., Investigational Report No. 272, 7 pp.

No definite change was detected in species composition, net catches, size or age distributions, or growth rates of native fish sampled during the 1963 survey as compared to that of 1959. The smelt population, however, has shown a substantial increase. The midsummer distribution of the smelt is restricted to the cold thermocline and hypolimnion while the native fish are confined to the warm epilimnion, because of their innate temperature preferences. Such temperature preferences effectively separate the fish populations into their respective ecological niches during the time of reproduction and most of the season for growth of the warm-water species. This minimizes the changes of predation and competition between smelt and young game fish. One exception is the observed intrusion of northern pike into the thermocline and their predation on smelt. (From Auth. Summ.)

7582. Wetzel, Robert G. (Dept. Zool., Univ. of California, Davis). 1964. PRIMARY PRODUCTIVITY OF AQUATIC MACROPHYTES. Verh. Internat. Verein. Limnol., Stuttgart, Vol. XV, pp. 426-436.

This investigation was designed to determine the relative significance of macrophytic primary productivity compared to the total photosynthetic carbon fixation in a shallow lake. A technique of assaying growth rates was developed employing carbon-14 as a tracer. Prior to in situ application, this technique was evaluated in laboratory cultures and compared to other methods commonly in use.

7583. Wetzel, Robert G. (Dept. Zool., Univ. of California, Davis). 1964. A COMPARATIVE STUDY OF THE PRIMARY PRODUCTIVITY OF HIGHER AQUATIC PLANTS, PERIPHYTON, AND PHYTOPLANKTON IN A LARGE, SHALLOW LAKE. Int. Revue ges. Hydrobiol., Vol. 49, No. 1, pp. 1-61.

The total primary productivity of a shallow saline lake of northern California was determined from August 1961 through July 1962. The productivity of each of the three major producer components, the phytoplankton, the periphyton, and the macrophytes, was measured separately and simultaneously using several carbon-14 techniques.

After reviewing the many methods that have been applied to biomass and productivity estimates of macrophytes and periphyton, a new technique was developed employing carbon-14 for the measurement of carbon fixation by these producers. Macrophytes and littoral periphyton were incubated in situ in specially constructed Plexiglas chambers

of variable sizes. The problem of self-absorption of the weak beta radiation was circumvented by complete combustion of the plants and radioassay of the $C^{14}O_2$ in gas phase. Incorporated carbon-14 of sessile periphyton was similarly determined by combustion of the algae directly from the rocks and debris.

The carbon-14 technique as applied to a measure of the macrophytic productivity is more sensitive than the oxygen method. This technique eliminates most of the error of the overestimation that results in the oxygen method from other autotrophic processes.

Productivity measurements of the phytoplankton, periphyton, and macrophytes of Borax Lake were compared to pigment and weight estimates of biomass. The results indicate that estimates of biomass can be misleading in determinations of the photosynthetic capacity of these producers. The annual productivity of the phytoplankton and periphyton of this lake was found to be similar. Productivities of each exceeded that of the only macrophyte (*Ruppia maritima* L.) in Borax Lake. The annual means of the phytoplankton, periphyton, and macrophytes were 249.3, 731.5, and 76.5 mg C/m²/day, respectively. The results indicate that littoral productivity could easily exceed that of the phytoplankton in certain ponds and lakes. Where volumes and littoral zone areas fluctuate considerably, as is frequently the case in shallow lakes, compensation for these changes is necessary for a realistic comparison among the primary producers. The total annual productivity, estimated on this basis, resulted in 101.0, 75.5, and 1.36 kg C/lake/day for the phytoplankton, periphyton, and macrophytes, respectively. Differences between productivity and standing crop values are discussed.

A distinct seasonal shift occurred in the size of plankters contributing to the total phytoplanktonic carbon fixation, similar to the findings in other lakes. During the winter the ultraplankton (0.5 - 10 μ) assume progressively greater significance. The larger plankton dominate (50 - 76 percent of the total) during the remainder of the year. Possible explanations of these observations are discussed. Pigment concentrations correlated with productivity measurements only during periods of rapid growth. A slight inverse relationship was found between the pigments of the phytoplankton and astacin carotenoids representative of the zooplankton. The data suggest grazing by herbivores as one of the factors limiting phytoplankton populations during the initial periods of low productivity.

Rainfall, relative turbidity and transparency, seston, and chlorophyll to sestonic weight ratios all indicate that the high turbidity of Borax Lake is largely abiogenic. For pigment analyses filter porosities of a micron in size were usually found to be adequate. The widely used HA Millipore filter (0.45 μ) is the practical lower limit for field studies and retains a major portion of the total seston. The latter filter size is suggested as a standard procedure for combining sestonic with pigment analyses.

Variations in the ionic composition of the extremely saline water of Borax Lake were analyzed for one year. Although the salinity fluctuated considerably in direct relation to lake volume changes, variations in ionic to total dissolved salt ratios were slight. Chlorides and carbonates are the major ions, ranging from 35.8 - 38.0 and 21.7 - 25.0 percent of the total, respectively. Unlike many saline lakes, sulphate concentrations in Borax Lake form a very minor portion of the total salinity. The water is highly buffered, deviating only slightly from a pH of 9.7. Salinity restrictions on the flora and fauna are discussed.

Boron concentrations were found to be extremely high in relation to those of other lakes. Quantities of inorganic boron fluctuated during the year from 440 ppm in March to 850 ppm in November. These changes were governed largely by rainfall dilution and evaporation of the lake. In situ and laboratory carbon-14 bioassay experiments indicated that natural phytoplankton populations have a high tolerance to boron concentrations considerably greater than those found in Borax Lake. Stimulation of growth by added boron was common in early spring when the environmental concentrations were increased. As natural boron increased during the summer, initial inhibitory responses were more acute to such additions. Rapid physiological adaptability to high boron concentrations, however, was evident. (Auth. Summ.)

7584. Scott, W. B., and E. J. Crossman (Dept. of Ichthyology and Herpetology, Royal Ontario Mus., Univ. Toronto, Toronto, Ontario, Canada). 1964. FISHES OCCURRING IN THE FRESH WATERS OF INSULAR NEWFOUNDLAND. Life Sciences, Royal Ont. Mus., Univ. Toronto, Contribution No. 58, 124 pp.

In 1960 the authors spent the month of July collecting by the use of seine and gill net in numerous lakes, streams, and estuaries from the Avalon Peninsula on the east to the Port au Port Bay region in western Newfoundland. During this period a total of 23 species were recorded and 3,100 specimens collected. Keys, drawings, maps, and photographs concerning the fishes of the island are included.

7585. Bailey, Reeve M., and Carl E. Bond (Oregon State Univ., Corvallis). 1963. FOUR NEW SPECIES OF FRESH-WATER SCULPINS, GENUS *COTTUS*, FROM WESTERN NORTH AMERICA. Occasional Papers of the Museum of Zoology, Univ. of Michigan, No. 634, 27 pp.

Suggests certain regrouping of the species of fresh-water sculpins and describes: *Cottus echinatus*, Utah Lake sculpin; *C. extensus*, Bear Lake sculpin; *C. confusus*, shorthead sculpin, collected in the Salmon River; and *C. pitensis*, pit sculpin, collected in North Fork of Pit River.

7586. Hill, Clifford W., Jr. (Montana State Coll., Bozeman). 1962. OBSERVATIONS ON THE LIFE HISTORIES OF THE PEAMOUTH (*MYLOCHEILUS CAURINUS*) AND THE NORTHERN SQUAWFISH

(PTYCHOCHEILUS OREGONENSIS) IN MONTANA. Proceedings of the Montana Academy of Sciences 22: 27-44.

These species are abundant native fishes in the Columbia River drainage of western Montana. Both grow to the size of many game fish but are little utilized as food and are generally classified as rough fish. They may compete with trout and salmon for food and space. The northern squawfish was reported to be an important predator on young sockeye salmon (Ricker, 1941; Foerster and Ricker, 1941). Both of these species take bait readily and are considered a nuisance by anglers. In view of the abundance and wide-spread distribution in western Montana, a study of their habits and life histories was undertaken as a part of the fisheries management program for the area. The drainage of the Big Blackfoot River was selected for the present investigation, which was carried out during the summers of 1956 and 1957.

7587. Wollitz, Robert E. (Montana State College Agricultural Experiment Station, Bozeman). 1962. EFFECTS OF CERTAIN COMMERCIAL FISH TOXICANTS ON THE LIMNOLOGY OF THREE COLD-WATER PONDS, MONTANA. Proceedings of the Montana Academy of Sciences 22: 54-81.

On July 16, 1957, an emulsifiable solution containing 60 percent toxaphene was applied to the East Pond at a concentration of 0.13 ppm. Observations and fishing (six 48-hour gill net sets) revealed no living fish one month following poisoning and it was assumed that a complete kill had been obtained. After treatment a marked change occurred in most physical and chemical properties. Visibility extended to the bottom. Turbidities decreased to less than 3.0 ppm almost immediately and to less than 1.0 ppm by the winter of 1957-1958. There was a decided change in certain chemical properties associated with the decrease in turbidity. Dissolved oxygen was greater than 100 percent saturation at all times; phenolphthalein alkalinity and pH increased while methyl orange alkalinity decreased. No change was observed in nitrates or phosphates. Treatment with toxaphene had considerable effect on the number of phytoplankters. Dinobryon showed a marked reduction and Ceratium completely disappeared. Following application of toxaphene, all Cladocera and Copepoda disappeared and did not reappear until September 20, 1957, when Bosmina and Cyclops were found. Ostracods disappeared after treatment and did not reappear before termination of this study. Protozoa were greatly reduced but did not completely disappear until August 15. They were not found following this date. Rotifers, while greatly reduced, were not completely eliminated. Neither Tendipedidae nor Tubificidae exhibited any noticeable reduction following treatment. Eight days following treatment, the number of gastropods was reduced; however, after 251 days following treatment, their combined total volume exceeded that for any time prior to treatment. Little change occurred in most phytoplankton following treatment with Chem-Fish Special. A small decrease in numbers followed

treatment with Pro-Noxfish and toxaphene but these are not significant. Bosmina, Cyclops, Keratella, and Polyarthra were much reduced 14 days following treatment with Chem-Fish Special. After treatment with Pro-Noxfish, Cladocera disappeared. Copepoda, Protozoa, and Rotatoria were greatly reduced. Treatment with Pro-Noxfish had little apparent effect on most groups of zooplankton.

7588. Domrose, Robert J. (Montana State College, Bozeman). 1963. AGE AND GROWTH OF BROOK TROUT, SALVELINUS FONTINALIS, IN MONTANA. Proceedings of the Montana Academy of Sciences 23: 47-62.

The combined data on brook trout for all the lakes and streams in this study showed a grand average calculated total length at annuli 1-6 of 3.0, 5.6, 7.9, 10.3, 14.4, and 14.2 inches, respectively. The growth rate of brook trout from the Beartooth Mountain lakes was only slightly less than the overall state average. The average calculated total lengths for 13 streams in New York (Hazzard, 1932) at annuli 1-3 were 3.5, 5.3, and 6.6 inches, respectively. Shetter and Leonard (1943) reported the average calculated total lengths at annuli 1-3 of 3.0, 5.0, and 6.8 inches, respectively, for a limited section of Hunt Creek, Michigan. Brook trout from New York streams were larger at the first annulus than the overall Montana average of the present study, while those from Hunt Creek were about the same as the Montana average. However, the Montana brook trout exceeded the average calculated total length of both New York and Michigan collections at the second and third annuli.

7589. Schoenthal, Norman D. (Montana State Coll., Bozeman). 1963. SOME EFFECTS OF DDT ON COLD-WATER FISH AND FISH-FOOD ORGANISMS. Proceedings of the Montana Academy of Sciences 23: 63-95.

Bioassays were conducted during the summers of 1957, 1958, and 1959 on 6000 cold-water fish to determine mortality rates under different concentrations of DDT and varying physical, chemical, and biological conditions. The mortality rate of hatchery and wild rainbow trout varied little with DDT concentrations between 0.5 and 10 ppm. Hatchery rainbow trout under 3.1 inches in length had a mortality rate of 100 percent at all concentrations. The mortality rate decreased as the size increased (66 percent for those over 5.0 inches). Wild rainbow trout under three inches had a mortality rate of 24 percent. Hatchery rainbow trout showed a 50 to 75 percent higher mortality than wild rainbow trout. The mortality rate of wild rainbow trout treated in 1 ppm DDT was affected by temperature, turbidity, alkalinity, and their interactions. Mortality increased with an increase in temperature and decreased with an increase in turbidity and alkalinity. The mortality rate of hatchery rainbow trout treated with 1 ppm DDT and those not treated with DDT was increased 13 to 22 percent by feeding aquatic insects treated with DDT. Exposing hatchery rainbow trout to algae treated with DDT did not increase their

mortality rate. A comparison of six species of cold-water fish over four inches in length tested in 1 ppm DDT showed that the longnose sucker had a mortality rate of 94 percent while the rainbow trout, cutthroat trout, brown trout, brook trout, and mountain whitefish had a mortality rate less than 10 percent. Delayed mortality occurred in all species of fish treated in DDT throughout a six-month observation period. Factors that influenced the mortality rate of fish treated in DDT were as follows: sources where collected, temperature change, disease, and method of handling before testing. Observations were made on fish and fish-food organisms in a test stream eight months before, during, and 19 months after treatment with DDT. DDT was applied at one point in the stream at a rate of 0.4 ppm. Trout populations in the first mile of treated water showed no significant change one year following treatment but below this point showed a 73 percent reduction. Analyses of trout stomachs exhibited a change in diet after treatment from immature aquatic insects to adult insects and aquatic vegetation. The immature aquatic insect population was reduced 99 percent in the DDT treated area within 6 days following application. DDT was toxic to aquatic insects 9.0 miles below the point of application. Immature aquatic insects regained pretreatment numbers, kinds, and volume 18 months after application. Diptera and Ephemeroptera were the first to repopulate the treated area followed in order by Trichoptera, Plecoptera, and Coleoptera. Immature aquatic insect populations below 0.75 mile downstream from the point of application of DDT required 11 months to regain 15 percent of the pretreatment numbers. It was in this same area that the food habits of the trout changed and a population reduction occurred. (Auth. Summ.)

7590. Johnson, Howard E. (Montana State College, Bozeman). 1963. OBSERVATIONS ON THE LIFE HISTORY AND MOVEMENT OF CUTTHROAT TROUT, SALMO CLARKI, IN FLATHEAD RIVER DRAINAGE, MONTANA. Proc. of the Montana Academy of Sciences 23: 96-110.

7591. Stober, Quentin J. (Montana State College, Bozeman). 1963. SOME LIMNOLOGICAL EFFECTS OF TIBER RESERVOIR ON THE MARIAS RIVER, MONTANA. Proceedings of the Montana Academy of Sciences 23: 111-137.

Observations to compare temperature, turbidity, and plankton in the Marias River above Tiber Reservoir, in Tiber Reservoir, and in the Marias River below during the summers of 1960 and 1961 were made. The reservoir stratified thermally both years, and a density current occurred in 1961. Water temperatures in the river below the reservoir were influenced by the level and volume of release, as well as by atmospheric conditions. Daily water temperatures below the reservoir averaged 12° cooler than those above in 1961. Maximum and minimum temperatures increased approximately 1.2° per mile for 11 miles downstream. The reservoir had a marked effect on temperatures at

least 24 miles below the dam. At stations below this, temperatures were approaching those of the river above. The shores of Tiber Reservoir are steep, soft, and easily eroded. A few turbidity samples collected near shore during heavy wave action ranged from 127 to 158 ppm. Turbidity in the reservoir ranged from 0.7 ppm to 185 ppm during 1960 and from 0.06 ppm to 110 ppm during 1961. Highest average turbidity readings were obtained in the upper end which was most affected by the inflowing river. Secchi disc readings in the reservoir ranged from 0.8 to 15.5 feet during 1960 and from 1.0 to 13.4 feet during 1961. Transparency was lowest near the head of the reservoir and increased progressively toward the dam. The average turbidity immediately below the reservoir was 14.1 ppm less than above the reservoir in 1960 and 10.3 ppm less in 1961. Turbidity increased downstream during periods when large volumes of water were released from the dam. Runoff from a severe storm increased turbidity in the river below the dam to the maximum recorded (465 ppm). Plankton numbers were extremely low in the reservoir, as well as in the river. The plankton in the river below the reservoir was largely indigenous and not contributed from the reservoir. Diatoms comprised over 90 percent and 85 percent of the total phytoplankton at each river station during 1960 and 1961. Cladophora was observed growing in dense mats in the riffle areas in the first six miles of river below the dam. Following high water and increased turbidity in 1961, the average total phytoplankton population was lower at all stations below the reservoir than in 1960. In general, the total average populations of zooplankton were greater below the reservoir than above, and a decrease in the population at successive downstream stations occurred. (Auth. Summ.)

7592. Moe, Martin A., Jr. (Florida Board of Cons. Mar. Lab., St. Petersburg). 1964. SURVIVAL POTENTIAL OF PIRANHAS IN FLORIDA. Quarterly Journal of the Florida Academy of Sciences, Vol. 27, No. 3, pp. 197-210.

Under favorable conditions, a mild winter, accidentally liberated piranhas may be able to survive and reproduce, and then natural selection would favor those individuals with the lowest temperature tolerances. Even if these fishes were able to withstand a few degrees of salinity, the problems developed by their importation are restricted to Florida's native fresh waters. The sole beneficial aspect of the presence of piranhas is that they are easy to catch with the proper equipment and are of good flavor with few bones. These fishes are not only a danger to men and livestock, but they also create havoc with fishermen by destroying hooked fish and fish nets. Their undesirability is evidenced by the efforts of the Brazilian government to eradicate them from the important inland water areas. Many thousands of dollars have been spent in poisoning these fishes with rotenone and in building dams to prevent reinfestation.

7593. Hubbs, Clark (The Univ. of Texas, Austin). 1961. DIFFERENCES BETWEEN THE GAMETE COMPATIBILITY OF ETHEOSTOMA LEPIDUM SPERM AND EGGS OF RELATED PERCID FISHES FROM ALLOPATRIC AND SYMPATRIC POPULATIONS. The Texas Journal of Science, Vol. XIII, No. 4, pp. 427-433.

Eggs of sympatric populations of orangethroat darters show reduced fertilization percentages with greenthroat darter sperm, whereas control and allopatric orangethroat darter eggs do not. Previously, the reciprocal has been shown, i.e., eggs of sympatric populations of greenthroat darters show reduced fertilization percentages with orange-throat darter sperm, whereas control and allopatric greenthroat darter eggs do not. These complementary results can best be explained by selection for an increase in efficiency of the isolation mechanism in sympatry. It is possible that similar results might occur in other studies of the biological nature of species and conflicting results between experiments based on different stocks. The difference in hybrid fertility between two sunfishes reported by Lagler and Steinmetz (1957) - fertile - and Hubbs and Hubbs (1933) - sterile - may well be due to reinforcement. Lagler and Steinmetz's "parents were seined from natural waters in Washtenaw County, Michigan," which has two river systems. As the stocks were pooled, allopatric crosses are possible. Most of the hybrids (and all of the pertinent species) checked for fertility by Hubbs and Hubbs were caught in nature and thus from sympatric stocks. Therefore, the apparent discrepancy in these results may involve reinforcement. Perhaps other contradictory results on the biological nature of species stem from the stocks used. Therefore, workers should consider the possibility of reinforcement of isolation mechanisms affecting their results. (Auth. Summ.)

7594. Hubbs, Clark, and George E. Drewry (The Univ. of Texas, Austin). 1962. ARTIFICIAL HYBRIDIZATION OF CRENICHTHYS BAILEYI WITH RELATED CYPRINODONT FISHES. The Texas Journal of Science, Vol. XIV, No. 1, pp. 107-110.

Eggs of four species of Fundulus and Lucania parva fertilized with Crenichthys baileyi sperm developed late embryos or hatched. The development was more or less normal in all of these hybrids except those based on Fundulus grandis eggs. Similar experiments based on Cyprinodon variegatus eggs died in late gastrula. (The lack of success with an Adinia egg is difficult to evaluate because of sample size.) The marked difference in success of crossing C. baileyi with Fundulus and its allies as compared with crosses with Cyprinodon indicates that Crenichthys is phylogenetically closer to the fundulines than the cyprinodontines. (Auth. Summ.)

7595. Miller, Robert Rush, and Clark Hubbs (The Univ. of Texas, Austin). 1962. GILA PANDORA, A CYPRINID NEW TO THE TEXAS FISH FAUNA. The Texas Journal of Science, Vol. XIV, No. 1, pp. 111-113.

7596. Hubbs, Clark (The Univ. of Texas, Austin). 1962. EFFECTS OF A HURRICANE ON THE FISH FAUNA OF A COASTAL POOL AND DRAINAGE DITCH. The Texas Journal of Science, Vol. XIV, No. 3, pp. 289-296.

7597. Kawatsu, Hiroshi. 1964. ON THE DIETARY DISEASE OF RAINBOW TROUT (SALMO IRIDEUS GIBBONS) CAUSED BY FEEDING THE DRIED SILK-WORM PUPAE. III. PREVENTIVE EFFECTS OF VITAMIN B COMPLEX AND VITAMIN E ON ANEMIA CAUSED BY THE DRIED SILK-WORM PUPAE. Bulletin of the Freshwater Fisheries Research Laboratory, Vol. 14, No. 1, pp. 1-9.

Numerous studies have been made on the dietary anemia of trout. Tunison et al. (1944) indicated that the trout anemia is due to the deficiency of riboflavin, pyridoxine and pantothenic acid, either singly or in combination. Other two combinations of folic acid, B₁₂ and niacin; or folic acid, B₁₂ and riboflavin were reported by Phillips et al. (1960). Recently, they concluded that folic acid is the primary cause of dietary anemia (Phillips et al, 1961, 1962).

In the previous report, it was noted by this author that the ether extracts, most probably rancid fat, of dried silk-worm pupae cause the fatty degeneration of liver and anemia. The present study was designed to see whether or not the anti-anemic vitamins reported by American workers or vitamin E prevent the anemia caused by the rancid fat in the dried silk-worm pupae.

In Experiment I, sixty fingerlings were held for 9 weeks in the tanks (90X45X45 cm) supplied with water of 16.6° C. The first group of fish, which is a control, received no vitamin supplement. The second group received vitamin E and the last group a vitamin B-complex, consisting of thiamine, riboflavin, pyridoxine, pantothenic acid, folic acid, and nicotinic acid. The blood cell counts and histological examinations were made on each of six fish at the end of experiments.

In Experiment II, fifty fingerlings (average weight 2.5 grams at start) were held in the same tanks used in Experiment I. The feeding of each group was terminated at the end of the week when the cumulative mortality reached 50 percent. The compositions of vitamin supplements were slightly modified to analyze the effects of each vitamin.

The results of these experiments are summarized as follows: (1) Neither riboflavin, pyridoxine, pantothenic acid, folic acid, thiamine, nicotinic acid, choline nor B₁₂ work preventive against the anemia due to rancid fat. Then, it seems reasonable to conclude that the anemia due to rancid fat is different, in its nature, from the dietary anemia reported by Tunison et al. or Phillips et al. (2) Although the decrease of erythrocytes was noted for both of vitamin-supplied and non-vitamin-supplied groups, the percentage of reticulocytes was more or less higher in the lots receiving a combination of riboflavin, pyridoxine, pantothenic acid, and folic acid. This may indicate that the fish receiving anti-anemic vitamins maintain the normal hematopoietic

function for a longer duration. (3) Vitamin E acts preventive against the anemia due to rancid fat, its preventive effect being strengthened by the coexistence of the anti-anemic vitamins. (4) Choline, one of the lipotropic agents for mammals, was ineffective in this type of anemia. (Auth.)

7598. Hubbs, Clark, and Kirk Strawn (The Univ. of Texas, Austin). 1963. DIFFERENCES IN THE DEVELOPMENTAL TEMPERATURE TOLERANCE OF CENTRAL TEXAS AND MORE NORTHERN STOCKS OF PERCINA CAPRODES (PERCIDAE: OSTEICHTHYES). The Southwestern Naturalist 8 (1): 43-45.

7599. Hubbs, Clark, and Harold J. Brodrick (The Univ. of Texas, Austin). 1963. CURRENT ABUNDANCE OF GAMBUSIA GAIGEI, AN ENDANGERED FISH SPECIES. The Southwestern Naturalist 8(1): 46-48.

7600. Scidmore, Warren J. (Minnesota Dept. Cons., St. Paul). 1961. SOME ASPECTS OF SPORT-FISHING YIELDS FROM MINNESOTA LAKES. The Minnesota Academy of Science Proceedings, Vol. 29, pp. 245-251.

Basically, Minnesota fish lakes are of four major types in terms of fish population structure. There are (1) lake trout lakes; (2) walleye lakes; (3) bass-panfish lakes; and (4) rough-fish-panfish lakes. There is much intergradation between these four types and for purposes of fish management it has been found useful to place most lakes in six major types. These are: (1) lake trout lakes of the northeast; (2) soft-water walleye lakes of the northeast; (3) hardwater walleye lakes, mostly of central and northern Minnesota; (4) the bass-panfish lakes of the southern and western part of the state; (5) bass-panfish-walleye lakes that are intergrades between types 3 and 4; and (6) the shallow rough-fish-panfish lakes of the southern and southwestern parts of the state. Northern pike are common fish in all these types except the lake trout lakes.

Creel census information was gathered on lakes of all six types. It will be noted that annual fishing yield is lowest in the lake trout and soft-water walleye lakes of the northeast where it is about 2 pounds per acre per year, and highest in the shallow and very fertile rough-fish-panfish lakes, nearly 40 pounds. The other types are intermediate in fishing yield, mean yields being 4.3 pounds for hardwater walleye lakes; 14.1 pounds for bass-panfish-walleye and 24.0 pounds for bass-panfish.

7601. Rabe, Fred W. (Idaho State Univ., Pocatello). 1964. A PHOTOGRAPHIC METHOD USED IN ENLARGING TROUT SCALES FOR GROWTH ANALYSIS. Proceedings of Utah Academy of Sciences, Arts and Letters, Vol. 41, Part II, 1 p. (Page number not listed.)

7602. Rabe, Fred W. (Idaho State Univ., Pocatello), and Vernon E. Dyer. 1964. AGE AND GROWTH STUDY OF BROOK TROUT FROM THREE CIRQUE

LAKES IN THE UINTA MOUNTAINS. Proceedings of Utah Academy of Sciences, Arts and Letters, Vol. 41, Part II, pp. 243-254.

Growth rates of brook trout populations from three adjacent alpine lakes were compared over five summers. Morphometric features, water temperatures, and chemical conditions of the lakes were much alike. Volumetric analyses of trout stomachs from Lake X-25 averaged 0.3, 0.1, and 0.3 cc during 1960, 1961, and 1962. Samples from X-26 averaged 0.3, 0.5, and 0.8 cc. Trout stomach samples from X-49 were 0.9, 1.2, and 1.8 cc over the same period. Midges and terrestrial organisms made up more than 75% of the diet of the fish in Lakes X-25 and X-26. Midges, beetle larvae and pupae and caddis larvae comprised the greatest percentage of total volume in samples from X-49. Trout from X-49 consistently exhibited the highest increments of growth followed by brook trout from X-26. Fish from X-25 were the slowest growing. Brook trout from different length groups in X-25 decreased in condition over the years. Fish sampled in 1962 and 1963 failed to reach lengths equivalent to those of the three preceding years. Some of the trout from X-25 had large heads and thin bodies following spawning. Many young-of-the-year were observed. Limited spawning took place in X-26 and X-49. Population estimates in 1960 revealed over 1,000 fish per acre in X-25 and about 600 per acre in X-26. Numbers were much less in X-49. The extensive shallow zones which contribute to the potential bottom food production, together with fewer numbers of fish present, accounted for the better growth rates in X-49. Differences in population density also explained the better growth in X-26 compared to X-25. Effects of artificial fertilization on brook trout growth in X-26 and X-49 could not be determined with any accuracy. Slight increases in periphyton and plankton were noted together with increases in the volumes of the fish stomachs following fertilization. (Auth. Summ.)

7603. Grimås, Ulf (Institute of Zool., Entomological Dept., Uppsala, Sweden). 1964. STUDIES ON THE BOTTOM FAUNA OF IMPOUNDED LAKES IN SOUTHERN NORWAY. Institute of Freshwater Research, Drottningholm, Report No. 45, pp. 94-104.

The qualitative composition of the bottom fauna was studied in the impounded subarctic lakes, Tunnehovdfjord, Paalsbufjord, and Rödungen, in southern Norway. The investigation is supplemented by quantitative material from Tunnehovdfjord.

Within the regulated zone, regions with a greater abundance, so-called refuges, were shown to exist in Tunnehovdfjord. Their importance as feeding grounds for fish is discussed. The specific composition of the fauna in the lakes exhibits deviations from the hitherto known picture of regulations. In spite of a wide amplitude of the water-level fluctuation the occurrence of the larger insect larvae is considerable in the lakes Tunnehovdfjord and Paalsbufjord. This is assumed to be due to the availability of organogenic material in the shape of drowned forest vegetation in the damming-up zones

of the lakes. The wealth of the shore fauna in Lake Rödungen is attributed to the slow rhythm of regulation in the lake in combination with the restricted amplitude of the water. The short- and long-term effects of the regulation upon the bottom fauna are discussed. (Auth. Summ.)

7604. Ito, Jun. 1964. FOOD AND FEEDING HABIT OF PACIFIC SALMON (GENUS *ONCORHYNCHUS*) IN THEIR OCEANIC LIFE. Bulletin of the Hokkaido Regional Fisheries Research Laboratory, No. 29, pp. 85-97.

An analysis was made on the stomach contents in 1,416 sockeye salmon (*Oncorhynchus nerka*), 1,511 chum salmon (*O. keta*), 1,305 pink salmon (*O. gorbuscha*), 351 coho salmon (*O. kisutch*), and 321 chinook salmon (*O. tshawytscha*), which were collected from the northwestern Pacific Ocean during the summers of 1958-1963. The main food was fishes, squids, euphausiids, amphipods, copepods, pteropods, and others. The salmon were classified into three groups, according to the food composition: Chinook-coho group, whose feeding habits are stenophagous and eat mainly squids and fishes; sockeye-pink group, whose feeding habits are euryphagous and eat squids, fishes, euphausiids, amphipods, and other planktonic animals; and chum group, which take mainly euphausiids, but sometimes eat pteropods and jelly fishes. The weight and composition of the stomach contents of pink salmon are different for odd and even years. In recent years, the average size of maturing pink salmon was smaller in odd years than in even years. In 1957 it seemed that the feeding conditions for pink salmon were the worst, due to low standing crops of zooplankton and high abundance of pink salmon stocks. (From Auth. Abst.)

7605. Galbreath, James L., and Richard L. Ridenhour (Fish Comm. Res. Lab., Route 1, Box 31A, Clackamas, Oregon). 1964. FECUNDITY OF COLUMBIA RIVER CHINOOK SALMON. Oregon Fish Comm., Research Briefs 10(1): 16-27.

Ovaries were collected from 62 female chinook salmon taken by commercial gill net fishermen in the Columbia River including spring, summer, and fall runs. After preservation, the egg content of each ovary was determined by actual count. Analysis of the data involved the computation of an overall length-fecundity regression line based on all samples, and investigation by analysis of covariance of the variability between seasons, age groups, and other river systems.

The number of eggs ranged from 2,148 for a 23-inch fish to 7,705 for a 41-inch fish with a mean of 5,090. The formula for the length-fecundity regression line was $\bar{Y} = -2,733 + 235X$, with a significant correlation coefficient of 0.87. This relationship did not deviate significantly from linearity, therefore it could be described as a straight-line relationship. Length-fecundity regressions from individual seasonal samples were computed as well as corresponding correlation coefficients, the values of which were all associated with significant proba-

bility levels. No significant differences were found between seasons.

Length-fecundity regressions were also computed for the four principal age groups in the sample. Tests indicated no significant differences between age groups. Since length is greatly influenced by time in the ocean, and fecundity is a function of length, fish of the same total age but with different periods of ocean life had different levels of fecundity.

A comparison was made between data collected in this study and data for the Klamath and Sacramento rivers. Klamath and Sacramento River samples had a fecundity range of 1,718-8,406 and 4,795-11,012, respectively, with means of 3,760 and 7,422. Analysis of covariance indicated a significant difference between the length-fecundity regressions for the three streams.

The length-fecundity relationship of Columbia River chinook was demonstrated to lie between that of the Klamath and Sacramento rivers. This suggested that some chinook races in the ocean catches could be separated in this manner. However, this method of racial identification cannot be considered reliable since overlapping in the length-fecundity relationship occurs, and does not consider other streams which have chinook populations. (Auth. Summ.)

7606. Ellis, Robert J. (U. S. Bur. Comm. Fish., Auke Bay, Alaska). 1964. THE EFFECT OF CONFINEMENT ON BLOOD LACTATE LEVELS IN CHINOOK AND COHO SALMON. Oregon Fish Comm., Research Briefs 10(1): 28-34.

The holding of fish in live tanks may contribute materially to high blood lactate concentrations. Use of unnatural confinement in the assessment of fatigue as a cause of mortality in troll-caught salmon should take into account the possible additional stress of such confinement. It is probable that although actively migrating salmon in fresh water may use the carbohydrate from transformation of body fat and protein as fast as it becomes available, they are able to accumulate some stores if given an opportunity to rest. (Auth. Concl.)

7607. Westgate, John W., and Thomas B. McKee (Oregon Fish Comm., State Office Bldg., Portland), and Duncan K. Law. 1964. RANKING OF WET INGREDIENTS FOR OREGON PELLETS. Oregon Fish Comm., Research Briefs 10(1): 35-40.

Tuna viscera, arrowtooth flounder (turbot), whole dogfish, dogfish without livers, and pasteurized salmon viscera were fed for 24 weeks to fingerling chinook salmon as wet components of the Oregon pellet. Good results were produced by all five ingredients. Dogfish and tuna viscera rated especially well. No advantage was realized by removing the livers from dogfish.

An early growth lag was noted in fish fed dogfish. This lag, which continued until the fish approximated 9 grams (50 per pound) in size, did not seem to be due to a diet deficiency because the fish converted their food exceptionally well but

may have been caused by unpalatability to the very young salmon. (Auth. Summ. and Concl.)

7608. Reimers, Paul E. (Oregon Fish Comm., State Office Bldg., Portland). 1964. A MODIFIED METHOD OF ANALYZING STOMACH CONTENTS WITH NOTES ON THE FOOD HABITS OF COHO SALMON IN THE COASTAL WATERS OF OREGON AND SOUTHERN WASHINGTON. Oregon Fish Commission, Research Briefs: 10(1): 46-56.

Coho salmon are probably opportunistic feeders. Generally, when herring, anchovies, and euphausiids were observed from the boat, they also appeared as dominant food items in the stomachs. Crab megalops were infrequently seen from the boat, possibly occurring mainly in deeper water.

The results of this study were quite similar to those of Heg and Van Hyning (1951) except that in the present work smelt (*Hypomesus pretiosus*) did not show any dominance and squid were not found. In Heg and Van Hyning's work euphausiids were important throughout the summer, but here they were important only in June off southern Washington.

Juvenile rockfish may have been ingested incidental to capture of crab megalops. Rockfish occurred in most coho stomachs containing the megalops and were also found to have crab megalops in their own mouths and stomachs.

A basic consideration to keep in mind with most methods of stomach analysis is that the results depict only the volumetric importance of each food item as found in the stomach. The nutritional value or usable energy that can be derived from each food item is more important, but seldom determined. Coho salmon doubling their weight as they do in their ultimate summer (Van Hyning, 1951) must eat large quantities of food and probably have a high conversion of energy in most food consumed.

The technique of transposing the length-weight curve to the stomach volume data and utilizing this curve to estimate potential volume undoubtedly needs refinement. A curve which gives a smaller potential volume for the shorter fish would more closely fit these data. A better estimation of the relationship between stomach potential volume and fish length could possibly be obtained by distending stomachs under a given pressure until maximum volume is attained. Another approach would be to plot the content volumes of a large number of full or nearly full stomachs against fish length and fit a regression line to the points.

Regardless of the initial problems of accurately estimating the potential stomach volume, the point allotment system holds promise in more accurately describing the food habits of a species. (Auth. Concl.)

7609. Kruse, Thomas E. (Oregon Fish Comm., State Office Bldg., Portland). 1964. A COMPARISON OF SPAGHETTI AND PETERSEN TAGS USED ON STEELHEAD TROUT AT GNAT CREEK, OREGON. Oregon Fish Comm., Research Briefs 10(1): 57-66.

Adult steelhead trout captured in a weir on Gnat Creek, a tributary to the lower Columbia River in Oregon, were tagged with Petersen disc and plastic spaghetti tube tags during 3 seasons (1955-58). The purpose was to obtain information on the relative merits of these two types of tags when used on salmonids.

In 3 seasons 214 steelhead were tagged with Petersen discs as they moved upstream. Of the 167 downstream recaptures, discs on 148 fish were judged to be in good condition, 8 were too loose, 1 was too tight, and 5 tags had been lost. Fifteen steelhead were recovered after 1 year's ocean residence (all seasons combined) with Petersen discs or tag scars. Of the tags on these fish, 5 were in good condition, 6 were too loose, 1 was too tight, 1 had cracked, and 2 had been lost.

Two hundred and seventeen spaghetti tags were placed on steelhead migrating upstream during the 3 seasons. A different type of plastic tubing was used each season. The first and second seasons the plastic became brittle and vinylite ink used on legends faded, making this combination unsuitable. The third season a translucent tubing with an inscribed insert proved satisfactory. Tag loss was 10% the first season, 8% the second, and none the third.

A statistical comparison of Petersen disc and spaghetti tags was made: (1) from fish returning downstream after spawning, and (2) on fish returning to the weir after ocean residence. The first year a significantly greater number of Petersen tags was recovered from downstream migrants. No difference could be demonstrated the following two seasons, when a better quality plastic tubing was used. Among tagged fish returning to the weir after ocean residence, no significant difference could be demonstrated between the two types of tags. After experimental problems were resolved, the spaghetti tags were favored over Petersen discs because they were more easily applied, more readily discernible, and caused less visible damage to the flesh of steelhead. (Auth. Summ.)

7610. Thomas, William H. (Univ. of California, Scripps Inst. of Oceanography, San Diego). 1964. AN EXPERIMENTAL EVALUATION OF THE C¹⁴ METHOD FOR MEASURING PHYTOPLANKTON PRODUCTION, USING CULTURES OF *DUNALIELLA PRIMOLECTA* BUTCHER. U. S. Fish and Wildlife Service, Fishery Bull. 63(2): 273-292.

The photosynthetic uptake of radioactive carbon dioxide was compared with net and gross O₂ production, pH changes, and growth in cultures of *Dunaliella primolecta* Butcher. During the logarithmic growth phase of such cultures, C¹⁴ uptake agreed well with net O₂ production and did not differ greatly from gross O₂ production. The logarithmic growth rate of mass cultures (measured by increases in cell concentration, optical density, dry weight, organic carbon and nitrogen) was generally less than a similar logarithmic rate calculated from organic carbon analyses and

measurements of photosynthesis in bottles immersed in the culture. This difference was attributed to greater illuminances in the bottles than in the cultures as a whole. In one experiment, when illumination conditions were similar, the two rates were equivalent.

When cultures were incipiently nitrogen-deficient, C^{14} uptake was similar to net O_2 production and growth was equivalent to photosynthesis. In one experiment, when nitrogen deficiency was extreme, C^{14} uptake was larger than net O_2 production, and agreed more closely with gross O_2 production. In another such experiment, C^{14} uptake agreed with net O_2 production. Nitrogen deficiency increased the intracellular C/N ratio, and starch became a major storage product. In one experiment C^{14} uptake in an incipiently phosphorus-deficient culture was intermediate between net and gross O_2 evolution; in a similar experiment, C^{14} uptake was less than net O_2 production. C^{14} uptake in healthy cultures was equivalent to the uptake of CO_2 as measured by pH changes. These results are discussed in relation to other findings and to oceanographic applications. (Auth. Abst.)

7611. Cleaver, Fred C. (U. S. Bur. Comm. Fish., Washington, D. C.). 1964. ORIGINS OF HIGH SEAS SOCKEYE SALMON. U. S. Fish and Wildlife Service, Fishery Bull. 63(2): 445-476.

To fulfill the requirements of the Protocol of the International North Pacific Fisheries Treaty, Canada, Japan, and the United States undertook a program of offshore fishery research in the North Pacific Ocean and Bering Sea. The studies have contributed much to understanding the distribution and migrations of sockeye salmon, *Oncorhynchus nerka* (Walbaum), at sea. The main objective of this report is to examine the available information concerning the origin of sockeye salmon that are found in different parts of the ocean. Several techniques have been successfully used to identify the sources of fish at sea. These include studies of parasites, movements of tagged fish, and scale differences and other morphological characteristics. The last provides most of the basis for quantitative statements regarding origin. Nearly all of the field work was done between early May and late September; accordingly, results are available for only this period. It was found that in early summer the maturing sockeye salmon north and south of the eastern and central Aleutian Islands were mainly of Bristol Bay, Alaska, origin. (Auth. Abst.)

7612. Marriott, Richard A. (Fisheries Research Inst., Univ. Washington, Seattle). 1964. STREAM CATALOG OF THE WOOD RIVER LAKE SYSTEM, BRISTOL BAY, ALASKA. U. S. Fish and Wildlife Service Special Scientific Report--Fisheries No. 494, 210 pp.

Information on the red salmon runs to all the major spawning tributaries in the Wood River lake system, Bristol Bay, Alaska, from 1946 to 1962 is cataloged in this report. The Wood River lake system comprises a chain of four main lakes with their

tributary lakes and creeks. The order of presentation is from lower to upper lakes and, within each lake, from the lake outlet around the lake in a clockwise order. A trunk stream or a connecting river is considered with the lake from which it drains. Included are 47 creeks, 11 belonging to Lake Aleknagik, 17 to Lake Nerka plus 3 to Little Togiak Lake which empties into Lake Nerka, 11 to Lake Beverley, 1 to Lake Mikchik, and 4 to Lake Kulik.

For each creek, there are three main entries. First, the catalog number, name, location, and physical description (which includes creek dimensions, potential spawning areas, bottom quality, flow, air and water temperatures) are given. On the following page, some cardinal points about the red salmon runs, including the average percentage of the total escapement, escapement range, time and peak of spawning, and distribution of the spawners, are given. Finally, a summary of surveys lists chronologically the estimated numbers of red salmon. (Auth. Abst.)

7613. Eschmeyer, Paul H. (U. S. Bur. Comm. Fish. Great Lakes Research, Ann Arbor, Michigan). 1964. THE LAKE TROUT (*SALVELINUS NAMAYCUSH*). U. S. Bureau of Commercial Fisheries, Fishery Leaflet 555, 7 pp.

7614. Armbruster, Daniel C. (P. O. Box 2751, Firestone Park Sta., Akron 1, Ohio). 1962. OBSERVATIONS ON THE LOSS OF WALLEYES OVER AND THROUGH BERLIN DAM. Ohio Dept. Natural Resources, Div. of Wildlife Technical Report, Publication W-64, 7 pp.

An estimated total of 19,102 walleyes were lost from Berlin Reservoir during the period from March 5, 1956, through April 11, 1961. This loss was estimated to have been comprised of 42 percent fish which were dead or would soon die of injuries sustained while escaping from the reservoir and 58 percent of fish which would survive in the waters below the dam. The losses occurred chiefly during the period from December through early April, when an ice cover was present and rapid reductions in lake levels were made. The largest numbers of fish were lost over the spillways when the tainter gates were opened, but these fish survived the passage. A smaller number were lost through the sluice gates but in general they were injured to such extent that they died. The heavy loss of walleyes during the winter of 1958-1959 was correlated with the reduced take of this species during the following season by both anglers and test nets. The fish lost were comprised chiefly of fingerlings which would reach one year of age the following spring. Although only 9.5 percent of the tags from fish marked in Berlin were returned, nearly 30 percent of the returns came from the water areas below Berlin Reservoir. In spite of losses of walleye from Berlin Reservoir, there has been a rather consistent production. This may be due to a periodic reduction in population pressure; but this reduction definitely improves angling downstream. (Auth. Summ. and Concl.)

7615. Mraz, Donald (Box 14, Delafield, Wisc.). 1964. OBSERVATIONS ON LARGE AND SMALL-MOUTH BASS NESTING AND EARLY LIFE HISTORY. Wisconsin Conservation Dept., Research Report No. 11 (Fisheries), 13 pp.

The purpose of this report is to assemble the various bits of knowledge accumulated over the past 10 years, which were outside the scope of the specific research project. The techniques presented and the discussion of common and unusual situations encountered will perhaps cut down the time loss of others who are called upon to make detailed observations on these two species. The fisheries man working with bass generally has about 2 weeks, but often less than one week, to make observations during the spawning season. Time wasted and observations lost cannot be made up until the following year. Also given are ideas and suggestions that should be useful to the small pond owner who raises bass. (Auth.)

7616. Balon, E. K. (Bratislava, Železná Studienka 806, Czechoslovakia). 1964. ON RELATIVE INDEXES FOR COMPARISON OF THE GROWTH OF FISHES. (O RELATÍVNYCH UKAZOVATEĽOCH PRE POROVNANIE RASTU RÝB.) Věstník Československé Společnosti Zoologické, Acta Societatis Zoologicae Bohemoslovenicae, Vol. XXVIII, No. 4, pp. 369-379.

To be able to compare the growth of a given species from various waters and various species from a given reservoir the author proposes new criteria. In view of the new significance of the relative growth values (Brjuzgin, 1960, 1963) the author defines with greater precision his previous growth rate index (Balon, 1963) and introduces individual symbolics and formulae.

To establish the rentability order it is enough to use the average absolute increases in the course of the juvenile and adult periods (φ_h) called "the index of the species average size." Economically preferred species reach an index of φ_h 4, 5, secondary species 4, 5 - 2, 5 and incidental species $\varphi_h < 2, 5$. Considered from the point of view of the sports and economic fishing, the fish of the first group are especially looked for, those of the second group are normally exploited and those of the last group are practically unexploited.

To be able to compare the relative growth values irrespective of the size objectively, the new index of the population weight growth intensity (φ_{Cg}) proved to be the most suitable. Should weight values not be available, it is possible to use a similar index of the linear growth intensity (φ_{C1}). (Auth. Summ.)

7617. Morton, William Markham (4700 N. W. Barnes Road, Portland, Oregon 97210). 1965. THE TAXONOMIC SIGNIFICANCE OF THE KYPE IN AMERICAN SALMONIDS. Copeia, 1965, No. 1, pp. 14-19.

Large adult male salmon that migrate considerable distances from their feeding to their breeding areas have long been known to develop large

heads and jaws which often are associated with the development of a pronounced "hump" in the back just posterior to the head. In the genus Oncorhynchus, the upper jaw elongates more than the lower jaw to form a "snout." In Salmo and Salvelinus, the lower jaw elongates more than the upper jaw and often develops a "hook" at its tip which fits into a groove in the upper jaw to form a "kype."

Among American species of Salvelinus, or chars, the kype reaches its maximum development in large males of the stream-spawning or anadromous forms, S. malma and S. fontinalis, whereas it is hardly discernible or is absent in large males of the lake-spawning or nonanadromous forms, S. alpinus and S. namaycush. Recent evidence of a kype developing in the anadromous or stream-spawning form of Arctic char may indicate that the Salvelinus alpinus complex should be split into 2 species in America, a lake-spawning or nonanadromous Arctic lake char, and a stream-spawning or anadromous Arctic brook char. (Auth.)

7618. Arai, Hisao P. (Dept. Biology, Univ. of Alberta, Calgary, Alberta, Canada), and Cathryn H. Koski. 1964. A NEW SPECIES OF TROCHOPUS (MONOGENEA: CAPSALIDAE) FROM SCORPAENA GUTTATA GIRARD. Canadian Journal of Zoology, Vol. 42, No. 6, pp. 1007-1010.

A new species of monogenetic trematode based primarily on the characteristics of the opisthaptor and anchors is described. The criteria constituting the genus Trochopus Diesing, 1850, are reconsidered. A key to the species of Trochopus is included (Authors)

7619. Ronald, K., H. C. Macnab, J. E. Stewart, and B. Beaton (Technological Research Laboratory, Fish. Res. Bd. of Canada, Halifax, Nova Scotia). 1964. BLOOD PROPERTIES OF AQUATIC VERTEBRATES. I. TOTAL BLOOD VOLUME OF THE ATLANTIC COD, GADUS MORHUA L. Canadian Journal of Zoology, Vol. 42, No. 6, pp. 1127-1132.

The volume of whole blood and plasma has been calculated for 22 specimens of the Atlantic cod (Gadus morhua L.) using a fluorescein dye. A definite correlation was found among blood weight, blood volume, and body weight. The whole blood was 2.4% and the plasma 1.8% of the total live weight of the fish. (Authors)

7620. Ali, M. A. (Max-Planck-Institut für Verhaltensphysiologie, 8131 Erling-Andechs/Obb, West Germany). 1964. RETINA OF THE ALBINO SPLAKE (SALVELINUS FONTINALIS X S. NAMAYCUSH). Canadian Journal of Zoology, Vol. 42, No. 6, pp. 1158-1160.

7621. Bonde, Thomas J. H., and Jerome H. Kuehn (Minnesota Div. of Game & Fish, 390 Centennial Bldg., St. Paul). 1963. STATE-WIDE AERIAL FISH HOUSE COUNT - 1963. Minnesota Div. of Game & Fish, Fish and Wildlife Surveys Unit, Investigational Report No. 264, 7 pp.

State-wide aerial counts covering an

undetermined but large percentage of the state's major fishing lakes showed that between 1952 and 1953 the number of fishing houses increased by 28.8 percent. A smaller subsample of these same lakes flown in 1963 and compared with the 1953 data on the same lakes indicates an increase between 1953 and 1963 of 120.3 percent.

The number of acres available per fishing house during this same period decreased from 74.1 acres in 1952 to 24.1 acres in 1963 or by about two-thirds over an 11-year period. (Authors' Summ.)

7622. Olson, Donald, and Merlyn Wesloh (Minn. Div. of Game & Fish, 390 Centennial Bldg., St. Paul). 1962. A RECORD OF SIX YEARS OF ANGLING ON MANY POINT LAKE, BECKER COUNTY, MINNESOTA, WITH SPECIAL REFERENCE TO THE EFFECT OF WALLEYE FINGERLING STOCKING. Minnesota Div. of Game & Fish, Investigational Report No. 247, 5 pp., 1 table, 1 fig.

Although no precise appraisal of the contribution of stocked walleyes to the Many Point fishery can be made, there appears to have been no increase in fishing success or increases in the harvest commensurate with the intensity of the stocking effort.

Walleye fingerling stocking in lakes with adequate walleye spawning facilities may provide a more stable fishery and possibly add to the total numbers harvested, but this could well be accompanied by a decrease in the average size of the walleyes with little increase in the pounds harvested. (Authors)

7623. Micklus, Robert C., and Merle W. Johnson (Minnesota Div. of Game & Fish, 390 Centennial Bldg., St. Paul). 1962. EVALUATION OF FISHING PRESSURE ON 30 MINNESOTA STREAM TROUT LAKES WITH ASSOCIATED ANGLING CATCHES, SUMMER, 1961. Minnesota Div. of Game & Fish, Investigational Report No. 248, 9 pp.

Estimation of fishing pressure by means of systematic aerial counts showed close agreement on three stream trout lakes and greater error on a managed lake trout lake when compared with ground creel census. Estimated man-hours for 27 northeastern Minnesota trout lakes ranged from zero on five lakes to 7,693 on Kimball Lake.

Six lakes were under quantitative creel census, four in the northeast and two in central Minnesota. Estimates ranged from 14 man-trips per acre on Twohey Lake to 152 man-trips per acre on Willard Lake, and from 7.4 pounds of brook trout per acre on Benson Lake to 45.1 pounds of rainbow trout per acre on Willard Lake. (Authors' Abst.)

7624. Olson, Donald E. (Minnesota Div. of Game & Fish, 390 Centennial Bldg., St. Paul). 1963. ROLE OF THE WHITE SUCKER IN MINNESOTA WATERS. Proceedings of the Minnesota Academy of Science, Vol. 31, No. 1, pp. 68-73.

A comparison of the food habits of the white sucker with game and panfish species in 1,716-acre Many Point was made along with sucker population and mortality estimates based on the recapture of

fin-clipped fish.

The food habits of suckers appear to be competitive with more desirable fishes for microcrustaceans and invertebrate bottom organisms. Suckers were not an important forage-species in the diets of other fishes. Microcrustaceans made up most of the diet of young-of-the-year suckers and as they grew older they shifted to a diet mostly of insects and mollusks.

Forage-fish found in the stomachs of predatory fishes were primarily perch and minnows; no identifiable suckers were found in the stomachs of 995 fish of 9 species.

Thirty-four percent of an estimated adult sucker population of 19 fish weighing 43 pounds per surface acre was removed by trapping and with electrofishing gear in the spring of 1959. To evaluate the effectiveness of this removal, the size of the sucker population was again estimated in the spring of 1960 and found to be similar to the pre-removal population. The removal of 34 percent of the estimated adult population was not considered successful in reducing inter-specific competition. The removal was offset by increased growth, recruitment, and survival of the remaining sucker populations.

Improvement of sport-fishing by reducing competition from suckers likely entails either: (1) complete elimination of suckers from the managed waters, or (2) a highly intensive and continuing annual removal. Complete removal can be considered for only small landlocked lakes. Even then, chances for reintroduction are great. A practical perpetual removal must rely on the development of low-cost, highly-efficient fishing methods. (Auth. Summ.)

7625. Brown, V. M., and W. L. Templeton (Radiobiology Group, U. K. Atomic Energy Authority, Windscale Works, Seascale, Cumberland, Eng.). 1964. RESISTANCE OF FISH EMBRYOS TO CHRONIC IRRADIATION. Nature, Vol. 203, No. 4951, pp. 1257-1259.

It is concluded that irradiation of fish eggs by either Sr⁹⁰ contamination or by an external radiation source at the levels used in these experiments where radiation doses of up to 500 rads were delivered chronically at a rate up to 1 r./h over the development period does not cause significant differences in the proportion hatching or in the number of abnormal larvae produced. There is a possibility that some damage is caused at the higher dose rates, but that this can only be detected and assessed by criteria more sensitive than embryonic death and larval mortality. Those now being considered include retardation of growth, death at some stage later than hatching, and production of chromosome aberrations.

7626. Elliott, J. M. (Dept. of Zoology, Univ. of Exeter, Devonshire, England). 1965. DAILY FLUCTUATIONS OF DRIFT INVERTEBRATES IN A DARTMOOR STREAM. Nature, Vol. 205, No. 4976, pp. 1127-1129.

Invertebrate drift was found to be an essential

part of the lotic environment and especially prominent at night. It is a potential food for salmonids and may well be especially important during the night. Terrestrial invertebrates are found chiefly in the surface drift, often in considerable numbers during the daytime. It is tentatively suggested that the greater drift activity at night is due to a decrease in light intensity with a corresponding decrease in the strongly negative phototactic behavior of the aquatic insects which form the invertebrate drift.

7627. Oppenheimer, Carl H. (Inst. of Marine Sci., Univ. of Miami, Coral Gables, Florida). 1963. EFFECTS OF HURRICANE CARLA ON THE ECOLOGY OF REDFISH BAY, TEXAS. *Bulletin of Marine Science of the Gulf and Caribbean*, Vol. 13, No. 1, pp. 59-72.

Hurricane Carla hit the Texas coast at Port O'Connor on September 8, 1961, with wind velocities up to 175 mph causing tides to 18.5 feet. A study of the effects of the storm immediately afterwards on Redfish Bay, 60 miles to the south of the storm center, showed the erosional effects caused by the water movement. The general ecological environments in the bay were not grossly affected by the storm. The sediments were disturbed to only a few mm and the grass beds were not damaged. (Auth. Abst.)

7628. Nose, Takeshi. 1963. DETERMINATION OF NUTRITIVE VALUE OF FOOD PROTEIN ON FISH. II. EFFECT OF AMINO ACID COMPOSITION OF HIGH PROTEIN DIETS ON GROWTH AND PROTEIN UTILIZATION OF THE RAINBOW TROUT. *Bulletin of Freshwater Fisheries Research Lab.*, Tokyo, Vol. 13, No. 1, pp. 41-50.

It has been well established that the trout needs a high protein diet and consumes a fairly large part of ingested protein to produce the metabolic energy. DeLong et al. (1958) reported that chinook salmon required 40 to 55% of protein in their diet and these values are two to four times higher than those of birds and mammals. With this in mind, the author studied the nutritional efficiency of high protein diets from the viewpoint of amino acid balance.

Synthetic diets were fed to rainbow trout varying in protein level and protein source. The nutritive value of protein was estimated by the growth, net protein utilization, and biological value by the method of Bender and Doell (1957).

In the preliminary experiment, rainbow trout fingerlings were reared with the casein-gelatin diet in four protein levels. Addition of L-methionine and L-tryptophan to the diet was found to gain in body weight at higher protein levels.

In the next experiment, five kinds of high protein diet, each on 70% protein level, were prepared by using casein, zein, gluten, gelatin or amino acids.

A linear relationship was observed between E. A. A. Index and percent gain in body weight, with the exception of zein diet to which no amino acid was reinforced. The zein diet supplemented with L-lysine and L-tryptophan was superior to the gluten

diet in growth-promoting effect. Even in the casein diet, which was provided with sufficient amounts of essential amino acids as determined by Halver (1961) for rainbow trout at 40% protein level, the addition of L-methionine and L-tryptophan resulted in increased weight gain.

The biological value of diets was also improved by the addition of the essential amino acids. The correlation coefficients between E. A. A. Index and biological value were quite similar, viz, 0.69 and 0.64, respectively, when the index was computed by adopting whole egg protein or body protein of rainbow trout as reference. Further study is necessary to find out the most suitable composition of amino acids for the high protein diet of trout.

The results of these experiments may suggest that the diet containing protein of good quality can produce faster growth and shows better protein conversion rate even on an elevated protein level. (Auth.)

7629. Kawatsu, Hiroshi. 1963. HEMOSIDEROSIS IN CULTURED RAINBOW TROUT (*SALMO IRIDEUS* GIBBONS). *Bulletin of Freshwater Fisheries Research Lab.*, Tokyo, Vol. 13, No. 1, pp. 51-56.

Hemosiderosis is characterized by the deposition of iron pigment (hemosiderin) in the tissues of organs. Hemosiderin can be seen as yellowish-brown granules by H-E staining and gives the prussian blue reaction.

The author observed the heavy hemosiderosis of spleen in the histological examinations of diseased trout in many culture ponds. Hemosiderosis was seen also in the kidney and liver, but the degree of deposition of hemosiderin was not so heavy as in the spleen.

The author has noticed in the diet experiments that anemic trout often develop hemosiderosis. In the initial stage of anemia, mature erythrocytes decreased, while the immature erythrocytes (reticulocytes) increased, so that the total number of erythrocytes maintained the normal count. When the formation of reticulocytes became impossible to compensate the destruction of mature erythrocytes, the total number of erythrocytes gradually decreased. In the more developed stages, reticulocytes began to decrease. In the last stage, the total number of erythrocytes decreased remarkably and the reticulocytes almost disappeared. The mean corpuscular diameter of erythrocytes grew larger and the segmentation of nucleus of erythrocyte was seen.

From these relationships, it may be possible that the hemosiderosis in spleen was the result of the destruction of blood cells and that the spleen plays the most important role as the destroying organ of the blood cells.

7630. Johnson, Murray G. (Metropolitan Toronto and Region Conservation Authority, Toronto, Ont., Canada). 1964. FISH BETTER - ELECTRICALLY. *Ontario Fish & Wildlife Review*, Vol. 3, No. 1, pp. 9-12.

The species composition and standing crops of

fish in sections of the Humber, Don and Rouge Rivers and Duffin Creek were estimated as a part of a pre-impoundment study. A 110 volt DC generator was utilized. Following each trip through the stream study sections, the fish collected were sorted by species and weighed. Photographs of the fish were taken in a box which contained several measuring scales. This technique saved valuable field time, as measurement of the lengths of fish could be made from photographs in the laboratory. The standing crops of stream fish varied from 15 to 220 pounds per acre with an average of 100 pounds. Factors which appeared to affect the size of the standing crop include the number of species, water temperatures, number of pools, and stream bottom type.

7631. Post, George (Utah Dept. of Fish & Game, Logan). 1964. THE IMMUNE RESPONSE OF RAINBOW TROUT (SALMO GAIRDNERI) TO AEROMONAS HYDROPHILA. Dissert. Absts. 24(7): 2659; Biol. Absts., Vol. 45, No. 16, Abst. No. 69793. 1964.

7632. Food and Agriculture Organization of the United Nations (Rome, Italy). 1964. A PARTIAL BIBLIOGRAPHY ON THE ECONOMIC EVALUATION OF SPORT FISHING AND FISHERIES RESOURCES. FAO Fisheries Circular No. 8 (Revision 1), 20 pp.

7633. Karvelis, Ernest G. (U. S. Bur. Comm. Fish., Ann Arbor, Michigan). 1964. THE TRUE PIKES. U. S. Fish and Wildlife Service, Fishery Leaflet 569, 11 pp.

Key for the identification of the muskellunge, northern pike, and pickerels. Also includes a description of their ranges, habitats, and life histories.

7634. Klement, Alfred W., Jr., and Vincent Schultz (Div. of Biology and Medicine, Atomic Energy Comm., Washington, D. C.). 1964. TERRESTRIAL AND FRESHWATER RADIOECOLOGY, A SELECTED BIBLIOGRAPHY (SUPPLEMENT 2). U. S. Atomic Energy Comm., Div. of Technical Information, TID-3910 (Suppl. 2), Biology and Medicine (TID-4500), 123 pp. (Avail.: Office of Technical Services, Dept. of Commerce, Washington, D. C., \$2.50.)

7635. Kimura, Masao (Dept. of Fishery, Fac. of Agriculture, Univ. of Miyazaki, Miyazaki, Japan). 1964. STUDIES ON DISEASES OF FISH UNDER CULTURE. II. ON A BACTERIAL DISEASE OF THE YELLOWTAIL, SERIOLA QUINQUERADIATA T. ET S. Bulletin of the Japanese Society of Scientific Fisheries, Vol. 30, No. 2, pp. 114-121.

Among a batch of small specimens of yellowtail transferred to a fish farm of Miyazaki Prefecture from Kochi Prefecture the majority were found suffering from the same disease which proved to be a bacterial one described as follows:

Diseased fish were mottled black on back from anterior border of first dorsal to posterior border of second dorsal as well as on lateral side of trunk.

Bad appetite and anemia were prevalent; sometimes ulcer was seen in alimentary canal and on epidermis. Blood congestion and swelling were evident in liver and kidney. Softening and weakening of their tissues increased with advancement of the disease. General dilatation of sinusoid occurred in liver accompanied by pycnosis of nucleus of liver cell. Necrobiosis of liver cells spread along blood cell wall. Shrinkage of renal corpuscles and their disintegration of urinary tubules, coupled with their degenerative fat infiltration, were also in the picture. Sporadically necrobiosis was found along blood vessels of spleen. Ellipsoid tissue was degenerated and vaguely defined from red marrow. Very remarkable catarrhal inflammation in the alimentary canal was seen, its intensity being worthy of noticing. A kind of pathogenic bacteria (gram, negative, short rod-like one) was isolated from spleen and muscle of diseased fish and successfully inoculated in intact specimens of the same species and allied forms to cause similar symptoms, but less and sometimes not at all, in other remotely related teleosts. (Auth.)

7636. Nakagome, Jun (Kanagawa Prefectural Fish. Experimental Station, Misaki, Miura, Japan). 1964. RELATION BETWEEN MONTHLY VARIATION OF HOOKING RATE OF YELLOWFIN TUNA AND MONTHLY VARIATION OF SURFACE WATER TEMPERATURE, AND BETWEEN ANNUAL VARIATION OF HOOKING RATE OF THE FISH AND ANNUAL VARIATION OF SURFACE WATER TEMPERATURE, IN THE TROPICAL ATLANTIC OCEAN. Bulletin of the Japanese Society of Scientific Fisheries, Vol. 30, No. 2, pp. 122-126.

The author has studied the relation between monthly variation of hooking rate of yellowfin tuna and surface water temperature and between annual variation of hooking rate of the fish and surface water temperature, in the tropical Atlantic Ocean.

The data on hooking rate and surface water temperature had already been provided for the purpose of studying seasonal variation and annual variation of hooking rate. The mean monthly hooking rate and surface water temperature are given; subarea values for the period from 1957 to 1962 which have been calculated and obtained from values having been given by month and by latitudinal and longitudinal division by 5°. The hooking rate and surface water temperature mean annual values are given calculated and obtained from values given by month and by subarea.

The author has obtained the following results: The monthly variation of hooking rate of fish has been concerned with that of surface water temperature; the hooking rate was high in periods when the surface water temperature was high and low in periods when the surface water temperature was low. The annual variation of hooking rate of the fish has been concerned with that of surface water temperature; the hooking rate was high in years when the surface water temperature was high and low in years when the surface water temperature was low. Accordingly, it is presumed that the

hooking rate will be high in any period and year when the surface water temperature is high and low in any period and year when the surface water temperature is low. But the monthly variation of the hooking rate has been reversely concerned with that of surface water temperature in area E; the hooking rate was low in periods when the surface water temperature was high. Also, the annual variation of the hooking rate has not been concerned with that of surface water temperature in areas F and H. In view of all above it is presumed that the width of adaptability of yellowfin tuna to water temperature is very large. (Auth.)

7637. Sugimoto, Hitomi, Masaya Suzuki, and Osamu Takeuchi (Naikai Regional Fish. Research Lab., Japan). 1964. STUDIES OF THE OIL POLLUTION ON THE FISHING GROUND IN SETO INLAND SEA. I. DISTRIBUTION OF OILY WASTES IN THE SEA. Bulletin of the Japanese Society of Scientific Fisheries, Vol. 30, No. 7, pp. 542-553.

The damages in fishery due to oil pollution have been intensified by a rapid development of oil industry in the area surrounding the Seto Inland Sea. The present investigation was carried out to grasp more accurately the general aspects of oil pollution of the sea induced by wastes from oil factories or refineries.

The possible sources of oily wastes are demonstrated and properties of wastes discharged from representative factories are summarized. The oil discharge from a factory is found to vary from 4 to 0.09 ton per day, when calculated from the volume of waste water and its highest oil concentration.

By the method established by the American Petroleum Institute, a distribution pattern of oil on the surface of the contaminated area of the sea was surveyed and the results indicate the two characteristic patterns. The floating oil distributes in patches differing in thickness as well as breadth and within a range not exceeding 4,000 m from the outfall of oily wastes. The latter phenomenon was considered to be due to the rapid disappearance of oily substances from the surface, partly due to volatilization, adhesion to a quay, or dispersion into the sea. In this connection, the volatility of several kinds of oil adhesion of oil to the suspending mud and distribution of the suspending matters in the sea and rivers were examined and it was suggested that the suspended particles in the sea may powerfully accelerate the dispersion of oil into the sea from the surface. (Authors)

7638. Sneed, Kermit E., and Harry K. Dupree (Southeastern Fish Cultural Lab., Bur. Sport Fish. & Wildl., Marion, Alabama). 1962. AN ELECTRICAL OXYGEN-TEMPERATURE METER FOR FISHERY BIOLOGISTS. U. S. Fish and Wildlife Service Special Scientific Report--Fisheries No. 426, 13 pp.

An oxygen-temperature meter, designed particularly for fishery biologists, was constructed and tested. The oxygen circuitry was modified from polarographic devices, and the temperature circuit consists of a Wheatstone bridge and thermistor

system driven by a transistor controlled, constant current regulator.

The platinum, silver-silver oxide electrode pair was imbedded in epoxy and weighted for measurements in any depth of water. When covered with a plastic membrane, the electrode response is not influenced by mild acids, alkali, salts, or pollution that does not dissolve or grossly foul the membrane. The increased hydrostatic pressure due to depth did not appreciably affect the electrode's linear response.

The electrode is temperature sensitive and has a positive coefficient of 3-8 percent per degree Centigrade, varying with the size of the working electrode and the thickness of the plastic membrane.

Circuitry, method of construction and directions for operation are included. (Authors)

7639. Hoffman, Glenn L., and Clarence E. Dunbar (Eastern Fish Disease Lab., Leetown (P. O. Kearneysville), West Virginia), and Arthur Bradford. 1962. WHIRLING DISEASE OF TROUTS CAUSED BY MYXOSOMA CEREBRALIS IN THE UNITED STATES. U. S. Fish and Wildlife Service Special Scientific Report--Fisheries No. 427, 15 pp.

This disease has recently appeared in North America for the first time. It appeared in a Pennsylvania trout hatchery and may have spread from there to the Lamar National Fish Hatchery which is on the same watershed, and from Lamar to the Kensington State Hatchery in Connecticut in transferred fish. The parasite develops in the cartilage, primarily of the head of very small trout. Symptoms of blacktail, whirling, spinal curvature and misshapen heads follow skeletal damage.

It was not possible to infect rainbow trout fry experimentally with the spores although the incidence was very high in one of the hatcheries. The development of the parasite was studied in infected fish brought from the Benner Spring Hatchery to Leetown. In histological sections the parasite can be seen as a small multinucleate trophozoite at 3 months after infection. The first spores can be seen at 4 months and persist for at least 3 years. Spores can be found in wet mounts prepared from head cartilage.

A program for control has been started, and the incidence appears to be declining in the Benner Spring Hatchery. The spring water reservoir was chlorinated, the ponds cleaned and potassium cyanamide applied. Acetarsone (Stovarsol) was fed to one lot of small trout at high concentrations with no noticed side effects, but control of whirling disease was not determined. (Authors)

7640. Combs, Bobby D., Wilton W. Heinemann, Roger E. Burrows, Allan E. Thomas, and Laurie G. Fowler (Salmon-Cultural Laboratory, Longview, Washington). 1962. PROTEIN AND CALORIE LEVELS OF MEAT-MEAL, VITAMIN-SUPPLEMENTED SALMON DIETS. U. S. Fish and Wildlife Service Special Scientific Report--Fisheries No. 432, 7 pp.

Feeding trials were conducted to determine

the effect on the nutrition of fingerling fall chinook salmon (*Oncorhynchus tshawytscha*) of feeding two protein levels, three caloric levels, vitamin fortification, and meat supplementation of a basic meal mixture for a 12-week period. The results were as follows:

A protein level of 25 percent produced significantly greater gains in weight and higher protein deposition than a protein level of 20 percent.

Caloric levels of 1300, 1650, and 2000 calories per kilogram of diet were fed. At the 20 percent protein level, an increase in caloric intake to 1650 calories, by the addition of peanut oil, increased the protein deposition and protein utilization. Increasing the calorie level to 2000 calories and retaining the 20 percent protein level did not increase either protein deposition or utilization above the 1650 calorie level. A sparing action on the protein, by the addition of supplemental energy calories, is indicated. The optimum protein to energy calorie relationship appears to be 1:1 in these diet combinations.

Fortification of the diets with a concentrated vitamin supplement had no measurable effect on either growth or mortality in these experiments.

Meat supplementations varying from 10 to 50 percent of the meat-meal combination produced no measurable differences in total gain, protein deposition, protein utilization, or mortality. (Authors)

7641. Ruggles, C. P. (Fish Culture Development Br., Dept. of Fish. of Canada, Halifax, N. S.), and P. Ryan. 1964. AN INVESTIGATION OF LOUVERS AS A METHOD OF GUIDING JUVENILE PACIFIC SALMON. The Canadian Fish Culturist, Issue 33, 68 pp.

The Fish Culture Development Branch of the Department of Fisheries of Canada conducted louver guiding tests on juvenile salmon at Puntledge River and Robertson Creek in British Columbia during the period 1957 to 1962. These tests were carried out for the purpose of evaluating louvers as a method for screening young salmon at an existing and a proposed hydroelectric project on Vancouver Island.

A chronological account of the development of the testing program is presented along with the results and conclusions. The results emphasize the need for careful testing before the louver principle can be adopted as a solution to a specific screening problem. The percentage fish deflection obtained shows that the following guiding efficiencies of a single line louver array could be expected under the conditions tested:

Sockeye smolts	85-95%
Coho smolts	85-95%
Chinook fry	65-75%
Coho fry	20-30%

Several factors affected the efficiency of the louvers in varying degrees. It should be kept in mind that all the tests were conducted in clear water, and it is not known if the results can be extrapolated to turbid water conditions or not. (From Auth. Summ.)

7642. Food and Agriculture Organization of the United Nations (Rome, Italy). 1964. EFFECTS OF UNDERWATER EXPLOSIVES ON AQUATIC LIFE. A BIBLIOGRAPHY AND LIST OF EXPERTS. FAO Fisheries Circular No. 2, Revision 4, 13 pp.

7643. U. S. Bureau of Commercial Fisheries (Fish and Wildlife Service, Portland, Oregon). 1964. COLUMBIA RIVER FISHERY PROGRAM - 1963. U. S. Fish and Wildlife Service, Bur. of Comm. Fish., Circular 192, 20 pp.

The Columbia Fisheries Program Office, established in 1958, is the principal representative of the Bureau of Commercial Fisheries in the Columbia Basin. It supervises the Bureau's major activities in the basin, except for biological and fish passage research, and is the Bureau's liaison office with State, Federal, and private agencies on salmon problems associated with water development projects in the basin. This circular outlines the background and the present program to preserve and develop the fish facilities of the basin.

7644. Copeland, B. J. (Inst. of Marine Science, Univ. Texas, Port Aransas), and W. R. Duffer. 1964. USE OF A CLEAR PLASTIC DOME TO MEASURE GASEOUS DIFFUSION RATES IN NATURAL WATERS. Limnology and Oceanography, Vol. 9, No. 4, pp. 494-499.

Experiments were conducted in both standing and moving water communities to evaluate the use of a plastic dome for correcting diurnal oxygen curves for diffusion of oxygen between the air-water interface. Diurnal oxygen curves in systems where diffusion of oxygen through the air-water boundary occurs were corrected by means of data from the plastic dome experiments to obtain curves in agreement with those from closed systems with no diffusion. The upstream-downstream diurnal oxygen curve method for running water ecosystems was modified to yield diurnal rate-of-change curves like those in still water. (Authors)

7645. Rigler, F. H. (Dept. Zool., Univ. Toronto, Toronto, Ontario, Canada). 1964. THE PHOSPHORUS FRACTIONS AND THE TURNOVER TIME OF INORGANIC PHOSPHORUS IN DIFFERENT TYPES OF LAKES. Limnology and Oceanography, Vol. 9, No. 4, pp. 511-518.

Concentration of three forms of phosphorus was measured in nine lakes throughout one year. The fraction occurring as soluble organic was similar in eight lakes. Results of previous workers were produced by using their methods of separating seston from the water. Use of a filter with 0.1- μ -diameter pores reduced the soluble organic fraction to 18% of the total. Turnover time of inorganic P was less than 10 min in all lakes during the summer but increased during the winter. (Auth.)

7646. Gorham, Evile (Dept. of Botany, Univ. of Minnesota, Minneapolis). 1964. MORPHOMETRIC CONTROL OF ANNUAL HEAT BUDGETS IN

TEMPERATE LAKES. Limnology and Oceanography, Vol. 9, No. 4, pp. 525-529.

Annual heat budgets of 71 lakes in the temperate zone are strongly correlated with mean depth and area. Depth and area influences taken together are responsible for an even higher degree of correlation between heat budgets and lake volumes. For lakes of a given volume, the deeper ones of lesser area appear to take up slightly more heat than the shallower ones of greater area. Dimictic lakes exhibit slightly higher heat budgets than warm monomictic lakes of similar size. Heat uptake appears to rise continuously with increasing lake dimensions, though at a decreasing rate, up to the largest dimensions observed. (Auth.)

7647. Goering, John J. (Inst. of Marine Science, Univ. of Alaska, College), and John C. Neess. 1964. NITROGEN FIXATION IN TWO WISCONSIN LAKES. Limnology and Oceanography, Vol. 9, No. 4, pp. 530-539.

Rates of biological nitrogen fixation in two Wisconsin lakes are given. In Lake Wingra, fixation continues at moderate rates throughout much of the ice-free season. In Lake Mendota, the rate is normally zero throughout the ice-free season, but occasional, sometimes high, rates are observed. Auxiliary experiments on the effects of incubation time, added glucose, added combined nitrogen, light intensity, and temperature on nitrogen fixation in lake water are discussed. The effect of incubation time on the rate of fixation varies from time to time. Glucose had no consistent effect on nitrogen fixation in the dark, although stimulation was observed in some experiments. In the light, glucose appeared to inhibit fixation. The effects of added ammonia and nitrate were inconsistent. At times, various added concentrations, particularly of ammonia, increased rates of nitrogen fixation. Rates of nitrogen fixation varied with light intensity. The rate increased to a maximum at 3,750 lux, then declined as the intensity increased further. Rates of nitrogen fixation increased at a constant rate with temperature in the range 16-30C. (Authors)

7648. Dean, David (Dept. Zoology & Entomology, Univ. Connecticut, Storrs), and Harold H. Haskin. 1964. BENTHIC REPOPULATION OF THE RARITAN RIVER ESTUARY FOLLOWING POLLUTION ABATEMENT. Limnology and Oceanography, Vol. 9, No. 4, pp. 551-563.

A total of 69 samples of benthic animals was taken in the lower 20 km of the Raritan River estuary from 1957 to 1960. During 1957, under heavily polluted conditions, no fresh-water species were discovered. Of the 17 marine species found, the barnacle *Balanus improvisus* extended 8.5 km above the river mouth; the remaining species were confined to the seaward 4.6 km of the river.

In January 1958 a trunk sewer system began operation in the lower Raritan Valley, and pollution was abated in the river. Rapid repopulation of the estuary occurred. The sequence and numbers of fresh-water and marine species invading the estuary

and colonizing the bottom sediments were followed in the samples of 1958, 1959, and 1960.

The most obvious change in 1958 was the distribution and density of *Balanus improvisus*. These barnacles coated all firm substrata in the previously uninhabited section, extending upriver to the limit of salt penetration. The 12 stations sampled in both 1958 and 1959 yielded 6 fresh-water and 21 marine species in 1958 and 8 fresh-water and 28 marine species in 1959. In 1960 fresh-water species continued to increase, but there was a slight decrease in the number of marine species. Dominant components of the fresh-water fauna were the oligochaetes *Limnodrilus* spp., the leech *Erpobdella punctata*, and the bivalve *Sphaerium* sp. A density of 7,102 organisms/m² was found at one of the fresh-water stations in 1960.

Marine species that invaded the river following pollution abatement are placed in five groups--three of pioneers, one of secondary invaders, and one of progressive penetrators--on the basis of their year of arrival, penetration, and length of stay.

By the end of the study, biotic recovery had so progressed that a plot of the quantitative distribution of species illustrated the classic V-shaped curve for estuaries. A similarly shaped curve was obtained for the distribution of population densities. (Authors)

7649. Loukashkin, Anatole S., and Norman Grant (California Academy of Sciences, San Francisco). 1965. BEHAVIOR AND NATURAL REACTIONS OF THE NORTHERN ANCHOVY, *ENGRAULIS MORDAX* GIRARD, UNDER THE INFLUENCE OF LIGHT OF DIFFERENT WAVE LENGTHS AND INTENSITIES AND TOTAL DARKNESS. Proceedings of the California Academy of Sciences, Fourth Series, Vol. XXXI, No. 24, pp. 631-692, 11 figs.

The present investigation was conducted in order to study experimentally the effects of various types of illumination on the northern anchovy, *Engraulis mordax* Girard, from the point of view of its ability to discriminate between different wave lengths of the light spectrum and different intensity values of the white light.

The discriminating ability of the anchovy in regard to different types of visible and non-visible light radiation was explored in the specially constructed dark room and an experimental wooden tank which was divisible into a number of light zones (in accordance with the nature of the experiment to be carried out).

In the two-zone experiments the following paired lights were tested: green-blue, green-red, green-white, green-darkness, blue-red, blue-white, blue-darkness, red-white, red-darkness, and white-darkness. Ultraviolet was tested in pairs with green, blue, red, white, and darkness; infrared with darkness or with white light.

In the three-zone experiments the following combinations of lights were tested: green-red-white, green-white-darkness, red-white-darkness, blue-red-darkness, and blue-green-white ('day-

light').

In the four-zone experiments the green-blue-red-darkness combination was tried.

In the two-zone experiments with monochromatic and white lights, the intensity was maintained uniformly at the 9 foot-candle level; in experiments with monochromatic lights and ultraviolet rays, the intensity was adjusted to the maximum intensity of the "black lamp" which was equivalent to 0.2 foot-candle. In other experiments using ultraviolet or infrared wave lengths and white light or darkness, the intensities varied from almost zero to 500+ foot-candles.

In the three- and four-zone experiments, the intensities of monochromatic and white lights tested were either uniform or of different values.

In all combinations of monochromatic and white lights, the effect of red light on the anchovy remained invariably negative in contrast to the sharply positive reaction of these fish toward other lights tested.

In two-zone choice experiments the positive reaction of the anchovy for green light was found to be 97.86 percent over the red (2.14 percent); 75.34 percent over white (24.66 percent); 73.18 percent over blue (26.82 percent). The preference for other lights, tested in pairs, was as follows: 81.60 percent for the blue light over red (18.40 percent), and 52.15 percent over white (47.85 percent); and 88.39 percent for white light over red (11.61 percent).

In the three- and four-zone experiments, the anchovies consistently demonstrated positive responses toward the green light as they did in the two-zone experiments. Even a considerable increase in the intensities of the opposing lights could not alter the positive reaction to green light.

In the two-zone experiments using ultraviolet light paired alternatively with green, blue, or red light, the anchovies displayed three conflicting responses. These responses were "indifference" in ultraviolet versus blue light (50.15 percent - 49.85 percent), "slightly negative" (45.21 percent) when ultraviolet was contrasted with green light (54.79 percent), and "highly positive" (71.97 percent) when it was paired with red (28.03 percent).

In the other two-zone experiments, when ultraviolet and white lights of much higher intensities were tested, the results were confusing as described above. With respect to the ultraviolet light, the responses of the anchovies varied from negative or avoidance (36:64), through indifference (50:50), to positive (72:28).

In experiments utilizing infrared radiation, the anchovies seemed totally unable to perceive it.

In experiments intended to test the ability of anchovies to differentiate among different white light intensity values, they seemed able to do so as evidenced in the tests with four and five intensity zones, and even more markedly in the two-zone experiments.

In the five-zone test arrangement in which intensities of light ranged from 2 to 100 foot-candles, the fish responded preferentially to the moderate intensities of the central zones (29.23 percent for the 20 foot-candle zone, and 41.94 percent for the 50 foot-

candle zone, or 71.17 percent for both).

In the four-zone test arrangement of white light used in intensities of 75, 125, 250, and 500 foot-candles, the anchovies reacted toward the moderate intensities of 125 foot-candles (30.21 percent) and 250 foot-candles (37.16 percent).

In the two-zone test experiments involving sharply contrasting intensities of 500 foot-candles, as a constant value, paired with much lower values ranging from 2 to 20 foot-candles, the reaction of the anchovies was always in favor (60.42 percent to 83.71 percent, averaging 68.52 percent) of the lower intensity values.

The experiments herein described and discussed reveal a few important factors in the reactions of the anchovy to light and darkness: (1) the anchovy is a phototactic animal; (2) it is capable of discriminating qualitatively between monochromatic (green, blue, red) and white lights; (3) it is able to distinguish green light from blue (the Pacific sardine failed to do so); (4) it shows a preference for green and blue lights over white; (5) it proved to react strongly negatively to red light. However, the fish tolerated this type of illumination when it was tested as an alternative to total darkness, and showed a highly positive response in such a case to the red light; (6) in its reaction toward the ultraviolet wave lengths it displayed a rather individualistic pattern of behavior; (7) it is unable to perceive infrared radiation; (8) it is capable of reacting differently to different intensities of white light ranging from 2 foot-candles to 500 foot-candles. (Authors' Summ.)

7650. McCrimmon, Hugh R., and Bryant Bidgood (Dept. Zool., Univ. of Guelph, Canada). 1965. ABNORMAL VERTEBRAE IN THE RAINBOW TROUT WITH PARTICULAR REFERENCE TO ELECTROFISHING. Transactions of the American Fisheries Society, Vol. 94, No. 1, pp. 84-88.

7651. Foye, Robert E., and Matthew Scott (Maine Dept. of Inland Fish. and Game, Augusta). 1965. EFFECTS OF PRESSURE ON SURVIVAL OF SIX SPECIES OF FISH. Transactions of the American Fisheries Society, Vol. 94, No. 1, pp. 88-91.

7652. Houser, Alfred (South Central Reservoir Investigations, Bur. Sport Fisheries and Wildlife, Fayetteville, Arkansas). 1965. GROWTH OF PADDLEFISH IN FORT GIBSON RESERVOIR, OKLAHOMA. Transactions of the American Fisheries Society, Vol. 94, No. 1, pp. 91-93.

7653. Hunt, Robert L. (Wisconsin Cons. Dept., Madison). 1965. FOOD OF NORTHERN PIKE IN A WISCONSIN TROUT STREAM. Transactions of the American Fisheries Society, Vol. 94, No. 1, pp. 95-97.

7654. Darnell, Rezneat M. (Dept. of Biology, Marquette Univ., Milwaukee, Wisconsin), and Richard R. Meierotto. 1965. DIURNAL PERIODICITY IN THE BLACK BULLHEAD, ICTALURUS

MELAS (RAFINESQUE). Transactions of the American Fisheries Society, Vol. 94, No. 1, pp. 1-8.

The 24-hour activity patterns of young and adult black bullheads have been investigated in a pool of a Wisconsin stream as well as in the laboratory. The young were found to exhibit two primary feeding periods in nature, one around dawn and the other around dusk. The young swim actively in schools during most of the daylight hours with an apparent depression of activity occurring around midday. They appear to be relatively inactive at night. Adults apparently remain inactive in the weed beds during the daylight hours, but they move around extensively at night. Trapping evidence suggest that the adults tend to forsake the pool during the early hours of darkness and return shortly before dawn. Feeding of the adults takes place after dark, but its exact timing is unknown. Behavior of the bullheads appears to be controlled by a combination of internal and external factors. Internal factors include hunger and "social appetite." External factors include food, other bullheads, and possibly light. (Authors)

7655. Rupp, Robert S., and Stuart E. DeRoche (Maine Dept. of Inland Fish. and Game, Orono). 1965. STANDING CROPS OF FISHES IN THREE SMALL LAKES COMPARED WITH C^{14} ESTIMATES OF NET PRIMARY PRODUCTIVITY. Transactions of the American Fisheries Society, Vol. 94, No. 1, pp. 9-25.

The standing crops of fishes which inhabited three small lakes were estimated immediately after rotenone treatment by combinations of procedures which included collections of all fish along the shorelines, from the surface waters offshore, and from the bottoms in shallow water; collections and counts from random sampling areas on shore and in shallow water; and collections and counts from randomly selected transect lines on bottom in deep water by SCUBA divers. Estimates of the net primary productivities of the lakes were made by the C^{14} method. When the lakes are ranked according to their estimated standing crops, the order of ranking is confirmed by the estimated net primary productivity of the most productive lake, but is in conflict with the productivity estimates from the intermediate and least productive lakes. Analyses of the structures of the fish populations of the lakes before reclamation and evaluations of techniques are also presented. (Authors)

7656. Eisler, Ronald (U. S. Bur. Sport Fisheries and Wildlife, Sandy Hook Marine Lab., Highlands, New Jersey). 1965. SOME EFFECTS OF A SYNTHETIC DETERGENT ON ESTUARINE FISHES. Transactions of the American Fisheries Society, Vol. 94, No. 1, pp. 26-31.

Acute toxicity of an alkyl benzene sulfonate (ABS) surfactant detergent to five species of juvenile estuarine fishes was determined at 20‰ salinity and 20° C. Concentrations of detergent that will kill 50 percent of the test organisms in 96 hours

ranged from 7.0 parts per million (ppm) for silver-sides, Menidia menidia, to 22.5 ppm for mummichogs, Fundulus heteroclitus. Intermediate in susceptibility were mullet, Mugil cephalus (10.1 ppm), winter flounder, Pseudopleuronectes americanus (8.2 ppm), and eels, Anguilla rostrata (7.5 ppm). After 12 weeks in solution, the synthetic detergent (syndet) retained most of its toxicity. The stock syndet contained 30.3 percent ABS at week zero as determined by the methylene blue method.

Salinity of the medium affects toxicity of the syndet. Eels which were exposed to 10 ppm syndet for 96 hours and mummichogs exposed to 20 ppm syndet for 120 hours were relatively unaffected at salinities below 15‰ but died at salinities approaching ocean strength.

Prolonged exposure of 150 days of juvenile mummichogs to syndet concentrations of 1, 2, 5, 8, or 10 ppm at salinities of 10, 20, 30, or 40‰, when compared to controls, did not significantly affect any biological variable measured (mortality, growth in length and weight, red blood cell number, gonadosomatic index, liver condition). (Auth.)

7657. Latta, William C. (Inst. for Fish. Research, Michigan Dept. of Cons., Vanderbilt). 1965. RELATIONSHIP OF YOUNG-OF-THE-YEAR TROUT TO MATURE TROUT AND GROUNDWATER. Transactions of the American Fisheries Society, Vol. 94, No. 1, pp. 32-39.

Estimates of the numbers of young-of-the-year and mature (age-groups I and older for the brook trout, and 9 inches and longer for the brown trout) brook and brown trout present in Sections B, C, and D of the Pigeon River were made each September 1949-60. Correlation coefficients (r) were calculated for the numbers of young-of-the-year trout and groundwater levels in October as measured in feet below land-surface datum at an observation well within the Pigeon River drainage. Calculation of the difference between the average minimum discharge (in cubic feet per second) at two streamflow gaging stations on the Pigeon River indicated the well measurements were reflected in the flow data. For the 9 years of available data, 1949-57, there was a highly significant linear correlation between numbers of young-of-the-year brook trout and groundwater levels; for the brown trout no correlation was evident. During years of high groundwater level, large numbers of young-of-the-year brook trout were present. Correlation coefficients calculated for the number of mature trout estimated to be present each September and the number of young-of-the-year trout present the following September, for 11 years of data, 1949-60, were nonsignificant for both brook trout and the brown trout. Analyses of variance of regressions of young-of-the-year trout on groundwater levels and mature trout for the years 1949-57 agreed essentially with the correlation coefficients. (Auth.)

7658. Chapman, D. W. (Idaho Cooperative Fishery Unit, Univ. Idaho, Moscow). 1965. NET PRODUCTION OF JUVENILE COHO SALMON IN THREE

OREGON STREAMS. Transactions of the American Fisheries Society, Vol. 94, No. 1, pp. 40-52.

Net production of juvenile coho salmon was estimated in three small streams in Oregon for 4 consecutive years. Annual net production of coho was greatly different in the 4 years, but production per unit area was similar among streams, averaging about 9 g/m² per year. No significant differences were found among streams in production per unit area for 14 months from emergence of fry one spring through seaward migration the next spring. For 4 years biomass averaged 5-12 g/m² shortly after emergence of fry, declining to 2-3 g/m² by July and remaining at about 2-4 g/m² until emigration of smolts in the following spring. In all years, mean production declined from 1.9-2.8 g/m² per month after emergence to 0.2-0.3 g/m² per month in winter, then increased to 0.5-0.6 g/m² per month prior to emigration. Monthly instantaneous growth rates were highest shortly after emergence of fry, declining until late winter, then increasing just before smolt emigration. The mean monthly instantaneous growth rate was about 0.19 for all streams and years. Yield of smolts as seaward emigrants ranged from 18 to 67 per 100 m². Net production was 1.5 to 3.0 times greater than yield as biomass of smolts. Net production of all fish in one stream containing coho, steelhead and cutthroat trout, and cottids was estimated to be 16 g/m² per year and compared with data from other waters. Relatively large freshets appeared to cause large downstream movements of juvenile coho. Downstream drift of postemergence fry and emigration of yearlings tended to bias estimates of growth and net production in the residual populations. (Auth.)

7659. Uzmann, J. R. (U. S. Bur. Sport Fish. & Wildl., Western Fish Disease Lab., Seattle, Wash.), G. J. Paulik, and S. H. Hayduk. 1965. EXPERIMENTAL HEXAMITIASIS IN JUVENILE COHO SALMON (*Oncorhynchus kisutch*) AND STEELHEAD TROUT (*Salmo gairdneri*). Transactions of the American Fisheries Society, Vol. 94, No. 1, pp. 53-61.

An exogenous strain of cultured *Hexamita salmonis* (Moore) was employed to induce trophic hexamitiasis in otherwise disease-free juveniles of coho salmon (*Oncorhynchus kisutch*) and steelhead trout (*Salmo gairdneri*). Mortality and growth were the parameters used to detect the effects of hexamitiasis on the two species. Two levels of each of the three experimental factors under study, *Hexamita* infection, species of fish, and density of fish, were arranged in a three-way factorial design. Replicate lots involved a total of 1,440 fish held under controlled laboratory conditions.

Comparisons of growth and mortality indicate that infection with *H. salmonis* over a period of 8 weeks is innocuous to coho salmon. Steelhead trout suffered a low, but statistically significant mortality which subsided after the sixth week; growth rate was not affected. (Authors)

7660. Eschmeyer, Paul H. (U. S. Bur. Comm.

Fish., Ann Arbor, Michigan), and Arthur M. Phillips, Jr. 1965. FAT CONTENT OF THE FLESH OF SISCOWETS AND LAKE TROUT FROM LAKE SUPERIOR. Transactions of the American Fisheries Society, Vol. 94, No. 1, pp. 62-74.

Samples of flesh were excised from the mid-dorsal region of 67 siscowets (*Salvelinus namaycush siscowet*) and 46 lake trout (*Salvelinus n. namaycush*) collected from Lake Superior. Chemical analysis of the samples revealed a range in fat content (dry weight) of 32.5 to 88.8 percent in siscowets and 6.6 to 52.3 percent in lake trout. Percentage fat increased progressively with increase in length of fish in both forms, but the average rate of increase was far greater for siscowets than for lake trout at lengths between 12 and 20 inches. Despite substantial individual variation, the percentage fat in the two forms was widely different and without overlap at all comparable lengths. The range in iodine number of the fat was 100 to 160 for siscowets and 103 to 161 for lake trout; average values were generally lower for siscowets than for lake trout among fish of comparable length. Percentage fat and relative weight were not correlated significantly in either subspecies. The fat content of flesh samples from a distinctive subpopulation of Lake Superior lake trout known as "humpers" was more closely similar to that of typical lean lake trout than to siscowets, but the rate of increase in fat with increasing length was greater than for lean lake trout. Flesh samples from hatchery-reared stocks of lake trout, hybrid lake trout X siscowets, and siscowets tended to support the view that the wide difference in fat content between siscowets and lake trout is genetically determined. (Authors)

7661. Rahrer, Jerold F. (U. S. Bur. Comm. Fish., Ashland, Wisconsin). 1965. AGE, GROWTH, MATURITY, AND FECUNDITY OF "HUMPER" LAKE TROUT, ISLE ROYALE, LAKE SUPERIOR. Transactions of the American Fisheries Society, Vol. 94, No. 1, pp. 75-83.

Humper lake trout are one of the several races or subpopulations of lake trout in Lake Superior. This study is based on 3,705 fish collected on a reef south of Isle Royale near the eastern end. The mean lengths of humper trout from commercial gill nets were smaller than those of lean lake trout. Members of age-groups VII, VIII, and IX represented 81.5 percent of the commercial humper catch. The body-scale relation was described by two intersecting straight lines. The weight of humper trout increased as the 3.282 power of the length. Growth in length was slow and ranged from 1.6 to 3.5 inches per year. Annual increments were greatest in the first, sixth, and seventh years. Growth in weight was also slow but increased each year. Humper trout became legal (1-1/2 pounds) in the eighth year of life and reached 5 pounds in 11 years. All fish longer than 19.1 inches and older than age-group VIII were mature; the shortest mature fish were: males, 12.7 inches; females, 14.7 inches. At minimum legal size, 98 percent of the males and 56 percent of the females

were mature. Humpert trout produced an average of 1,351 eggs per fish or 516 per pound. (Auth.)

7662. Churchill, Warren, and Howard Snow (Wisconsin Conservation Dept., Madison). 1964. CHARACTERISTICS OF THE SPORT FISHERY IN SOME NORTHERN WISCONSIN LAKES. Wisconsin Cons. Dept., Technical Bulletin No. 32, 48 pp.

This paper summarizes certain information on the fisheries of two research projects on waters of northern Wisconsin. These projects, Five Lakes and Murphy Flowage, were established in 1946 and 1955, respectively, to study fish populations and the effect on them of various management procedures. This led to a study of angling practices and variations in fishing pressure and success that might influence the results of management. In view of the importance of the sport fishery in northern Wisconsin, it was felt that this information would also be of interest to all who are connected with the tourist industry and recreational planning.

On the assumption that the findings on these lakes are generally true throughout the north country, it is possible to draw certain conclusions for the guidance of anglers, managers, and planners in Wisconsin.

For the Angler: The highest rate of catch of both game fish and panfish occurs in the winter, and the lowest for most species in the summer vacation season. This is partly due to the larger proportion of experienced anglers in the winter. In open water, fly fishing and still fishing with worms are the most successful methods for panfish. Trolling is most successful for game fish. Minnows are the most effective bait for walleyes and northern pike, artificial baits are best for bass. However, anglers appear to respond quickly and often successfully to new baits. The most successful anglers are those that either fish the same lake a number of times or hire a guide. Skill is more important than luck. Boat anglers are successful more often than those that fish from shore. They catch fewer panfish but more game fish. The water is less crowded, and the fishing at least as good, in early morning and evening.

For the Manager: Most fish are caught by relatively few of the anglers. A bag limit would have had little effect on the total catch of fish from these lakes because few anglers caught more than the usual limits. The principal exception would have been the catch of bluegills from Murphy Flowage, where these fish are exceedingly abundant. Information on this point from other lakes is needed. Game fish bite readily during the period when the season on them is usually closed. About one-fifth of the fishing is done by anglers who do not need a license under present regulations. Panfish are the most sought after, and make up over 90 percent of the catch. The average fishing trip lasts about 4 hours. Boat anglers fish longer hours than bank anglers.

For the Planner: Few anglers came to northern lakes from more than 500 miles away. Within this range, centers of population are represented more

in proportion to their size than to their distance from the lakes. Non-resident anglers do relatively little ice-fishing in Wisconsin. Few ice fishermen come from more than 100 miles away. Over 20 percent of the fishing is done by women and girls. More than half of the fishing is done in the short period between June 1 and September 15. In resort country, fishing is fairly evenly distributed throughout the week; where there is a sizable local population, it is heavier on weekends. Bluegill fishing is an excellent form of winter recreation that could be publicized extensively. (Auth. Concl.)

7663. Ozaki, Hisao. 1963. LETHAL DOSES OF PCP-NA IN FISHES. Journal of Faculty of Fisheries, Prefectural Univ. of Mie (Japan), Vol. 6, No. 1, pp. 1-25.

The lethal doses and lethal concentration of PCP-Na, survival time and intoxication symptom were studied in the fresh-water fishes Carassius auratus, Cyprinus carpio, and Oryzias latipes by immersing into solution of varied PCP-Na concentration, by intraperitoneal injection of PCP-Na Ringer's solution and by per os administration of PCP-Na Ringer's solution.

The intoxication symptom of Carassius injected PCP-Na was similar to that in PCP-Na solution. The symptom was characterized by acceleration of respiratory opercular movement, failure of body equilibrating, struggle fit, and nystagmus, etc. The relation between PCP-Na concentration and survival time of fish in PCP-Na solution was studied. The lethal concentration was about 0.2 ppm, which is the same as those observed by many authors with different fishes. The per os lethal dose in Carassius was 45% per body weight (g), which is higher than that by injection. The injection lethal dose of PCP-Na was 25% per body weight (g), which is unexpectedly higher than that estimated from the lethal concentration of PCP-Na (0.2 ppm). From lethal concentration, survival time, lethal doses and recovery experiment from PCP-Na intoxication, we deduce (1) that PCP-Na is permeable to gill membrane and perhaps other biological membranes; (2) that PCP-Na is accumulated within fish body from ambient PCP-Na solution up to the lethal dose at which fish do die; and (3) that PCP-Na is rather rapidly metabolized or decomposed into inactive substance(s), or removed through unknown path(s). The correlations between lethal concentration, survival time and injection lethal dose were quantitatively discussed with success in introducing value of respiratory water volume and presumptive rate of PCP-Na absorption at gill membrane. (Auth.)

7664. Kubota, Saburoh S., and Mitsuaki Takakuwa. 1963. STUDIES ON THE DISEASES OF MARINE-CULTURE FISHES. I. GENERAL DESCRIPTION AND PRELIMINARY DISCUSSION OF FISH DISEASES AT MIE PREFECTURE. Journal of Faculty of Fisheries, Prefectural Univ. of Mie (Japan), Vol. 6, No. 1, pp. 107-124, 5 plates.

On the representative diseases occurring in the marine fishes which are cultured in Mie Prefecture,

a general description and a preliminary discussion were given.

The diseases occurring in the cultured fishes may be divided primarily into two categories. One is the diseases caused by pathologic organisms, and originating in bacterial and parasitic infection. The other is functional diseases and sporadic ones of unknown etiology.

The diseases caused by pathologic bacteria are represented by the boil infection of halophilic vibrio and the infectious dermatitis by *Pseudomonas*. The parasitic diseases arise from the infection of *Benedenia seriolae* (skin parasite), *Axine heterocerca* (gill parasite), *Caligus amplifurcus* (skin parasite), and several kinds of *Copepoda* (skin or gill parasites).

In the functional diseases, the diagnosis based upon symptoms is difficult in most of the cases. There are a small number of diseases, the origin of which can easily be explained, such as melanisms (so-called blackened specimens) by intoxication, vertebral adhesion with abortion, cataract and blindness originating in dystrophy, disturbances of fatty metabolism and rheum caused by sudden change of water temperature, indigestion by frozen diets, and disturbance of the blood circulation.

In many cases, these diseases are liable to interact with one another. The prevention of fish diseases by supplying with proper foods and controlling the environmental factors are better than applying treatments. (Authors)

7665. Kubota, Saburoh S., and Kenji Hagita. 1963. STUDIES ON THE DISEASES OF MARINE-CULTURE FISHES. II. PHARMACO-DYNAMIC EFFECTS OF NITROFURAZONE FOR FISH DISEASES (1). Journal of Faculty of Fisheries, Prefectural Univ. of Mie (Japan), Vol. 6, No. 1, pp. 125-144, 3 plates.

The present study was undertaken for the purpose of investigating the pharmacological effects of nitrofurazone (monafuracin) on fish diseases and its toxicity on fishes. This is the first of a series dealing with the problem and was based on three basic experiments and a practical example.

By comparing the survival length of time of nine kinds of fishes cultured in the nitrofurazone solution, the differences in its toxicity were examined. The fresh-water fishes were found to survive for several days, even if they were immersed in the saturated solution, while the marine fishes were generally easily affected by its poisoning action. Yellowtail (*Seriola quinqueradiata*), for example, was liable to suffer with blackened disease when the immersion lasted for too long a time, or too large a dose of this chemical was orally administered.

Pathological and histological studies on the promotion of regeneration effected by nitrofurazone against the artificial trauma was made using "Kawabatomoroko" (*Hemigramocypris rasborella*) as material. The fishes bathed in nitrofurazone solution (ca. 1/150,000) showed far earlier regeneration than the control did. A prompt immersion after injury proved most effective in healing without necessitating long-time treatment.

In the guppies (*Lebistes reticulatus*) cultured in the saturated solution of nitrofurazone, the spermatogenesis in the seminiferous tubules went on without showing any histological inhibition. In the female fed with nitrofurazone the embryos were still growing.

Oral administration of nitrofurazone had a good effect upon yellowtail infected with bacterial diseases (vibrio infections by *Vibrio anguillarum*). The adequate dose was less than 56 mg/kg body weight/day, but administration over four days should be avoided because of the increase of side effects.

From the prophylactic viewpoint, nitrofurazone proved effective. In the experiment undertaken at Kuki district, the nitrofurazone-solution bathing successfully prevented bacterial infections in yellowtail and, at present, the death from infectious diseases is rare there.

As nitrofurazone proves to be an effective agent against the bacterial diseases of fishes, it is desirable to determine the dose and the administration method adequate for each fish species. (Authors)

7666. Gerking, Shelby D. (Dept. Zool., Indiana Univ., Bloomington). 1965. TWO COMPUTER PROGRAMS FOR AGE AND GROWTH STUDIES. The Progressive Fish-Culturist, Vol. 27, No. 2, pp. 59-66.

Two self-contained IBM 709 computer programs for age and growth research on fish populations are described in detail. The first program computes the relation between length and scale radius and between length and weight, producing regression equations, standard deviation of the regression coefficient, and the x-intercept for each of eight lakes and the total of all lakes, as well as tables showing the mean scale radius and mean weight for each of 40 5-mm length intervals. The second program produces a standard "length at each age" table for all fish collections from each of eight lakes and the total of all lakes; it computed the growth achieved from the time of formation of the last annulus to the time of collection for 14 arbitrarily selected periods of the year. (Auth.)

7667. Wolf, Ken (Bur. Sport Fisheries and Wildlife, Eastern Fish Disease Lab., Kearneysville, West Virginia). 1965. SOME RECENT DEVELOPMENTS AND APPLICATIONS OF FISH CELL AND TISSUE CULTURE. The Progressive Fish-Culturist, Vol. 27, No. 2, pp. 67-74.

Today's methods and applications of fish cell and tissue culture are described and illustrated. Generalized methods of preparing primary monolayer cell cultures are discussed, and pertinent principles are noted. Development, advantages, and examples of established fish cell strains are reviewed, and some research applications of cultivated fish cells are cited. (Auth.)

7668. Dendy, J. S. (Auburn Univ. Agricultural Experiment Station, Auburn, Alabama). 1965.

USE OF WOODS TO DETERMINE THE DEPTHS OF OXYGEN DISTRIBUTION IN PONDS. The Progressive Fish-Culturist, Vol. 27, No. 2, pp. 75-78.

Woods light in color and rich in tannin (tannic acid) stained darkly when exposed for 30 to 45 minutes in pond waters that contained less than approximately 0.1 ppm of dissolved oxygen. No dark staining occurred in waters that contained concentrations of dissolved oxygen sufficient to support fish. (Auth.)

7669. Elser, Harold J. (Natural Resources Inst., Univ. Maryland, Annapolis). 1965. EFFECT OF A WARMED-WATER DISCHARGE ON ANGLING IN THE POTOMAC RIVER, MARYLAND, 1961-62. The Progressive Fish-Culturist, Vol. 27, No. 2, pp. 79-86.

Fishing in the warmed-water discharge from an electric-generating plant was better (more fish caught per trip) for nine months of the year than in the unheated part of the river. For about two months there was no appreciable difference; during one month, in midsummer, fishing was poorer. Channel catfish formed the bulk of the catch, but smallmouth bass and the smaller sunfishes appeared in significant numbers. The temperature spectrum for good fishing appeared to be very broad. Tests were made by three paid anglers who fished year-round on an experimental design. (Auth.)

7670. Steucke, Erwin W., Jr. (U. S. Bureau of Sport Fisheries and Wildlife, P. O. Box 862, La Crosse, Wisconsin), and Charles R. Atherton. 1965. USE OF MICROHEMATOCRIT VALUES TO SEX LARGEMOUTH BASS. The Progressive Fish-Culturist, Vol. 27, No. 2, pp. 87-90.

The use of hematocrit values in the sex identification of 157 largemouth bass is evaluated. A surgical technique used for positive sex determination is described. The mean hematocrit value established for males was 47.2 and the mean value for females was 38.2. The average mean hematocrit for all fish was 42.7. Use of the average mean hematocrit value as the criterion for separating the sexes resulted in 85% of all male fish having values above the average mean and 82.5% of the females having values below the mean. Only when fish with values above the value of 47.2 are considered males and fish with values below 38.2 are considered females, do results fall within the desired statistical limits. However, because of the large overlap of fish with intermediate values, only 48% of the total sample could be defined by this method. (E. W. Steucke, Jr.)

7671. Crance, Johnie H. (Alabama Dept. of Cons., Montgomery, Alabama). 1965. FISH KILLS IN ALABAMA PONDS AFTER SWARMS OF THE IMPORTED FIRE ANT. The Progressive Fish-Culturist, Vol. 27, No. 2, pp. 91-94.

Fish kills in numerous ponds in Alabama were investigated in 1960, 1961, and 1963 during the season when maximum daily temperatures had

reached 75°-80° F. Practically all fish examined contained winged forms of the imported fire ant, *Solenopsis saevissima* V. *richteri* Forel. Observations indicated that the winged fire ants caused death of the fish. (Auth.)

7672. Poston, Hugh A. (U. S. Bureau of Sport Fisheries and Wildlife, Cortland, New York). 1965. EFFECT OF A DIETARY PROGESTATIONAL COMPOUND ON BLOOD PROPERTIES, CHEMICAL COMPOSITION, AND GROWTH OF IMMATURE BROOK TROUT. The Progressive Fish-Culturist, Vol. 27, No. 2, pp. 95-98.

The addition of a progestational compound to the diet of immature brook trout (*Salvelinus fontinalis*) resulted in a significant decrease in trout growth and microhematocrit values. At the end of the experiment the fish fed the progestational compound averaged 35.8 g, as compared to 39.2 g for the control fish. At the end of 20 weeks the average microhematocrit value for trout fed the compound was 34.2%, compared to 40.9% for the controls. Neither blood coagulation time, gonad weights, nor gross chemical composition of the trout was significantly affected. (Auth.)

7673. Fryer, John L. (Oregon State University, Corvallis), and John F. Conrad. 1965. SOME OBSERVATIONS ON FURUNCULOSIS IN ADULT PACIFIC SALMON AND STEELHEAD TROUT. The Progressive Fish-Culturist, Vol. 27, No. 2, pp. 99-100.

Aeromonas salmonicida, the etiological agent of furunculosis, was diagnosed in adult spring and fall chinook salmon (*Oncorhynchus tshawytscha*), coho salmon (*O. kisutch*), and steelhead trout (*Salmo gairdneri*) from eight locations in Oregon. (John L. Fryer)

7674. Rabe, Fred W. (Univ. of Utah, Salt Lake City). 1965. PERIPHYTON GROWTH IN HIGH LAKES. The Progressive Fish-Culturist, Vol. 27, No. 2, pp. 101-104.

Glass slides exposed in the water for two 30-day periods in 1960 yielded low organic weights in five alpine lakes. These results were consistent with the small amounts of dissolved solids present. After four of the lakes were fertilized in 1961, periphyton weights increased more than eight times in one lake; less increase was noted in the other three experimental waters. The control showed the least change. Heavy nannoplankton blooms were probably responsible for the periphyton reduction in one lake during the second period, 1961. (Auth.)

7675. Haskell, D. C. (Rome, New York). 1965. ARE WE LOOKING IN THE RIGHT DIRECTION IN FISHERY RESEARCH? The Progressive Fish-Culturist, Vol. 27, No. 2, pp. 105-107.

Causes of low survivals in planted hatchery trout and in native wild trout are discussed. It is suggested that the development of research methods adaptable to studies of the causes of low

survivals will permit great improvement by fishery management. (Auth.)

7676. Post, George (U. S. Bureau of Sport Fisheries and Wildlife, Cooperative Fishery Unit, Fort Collins, Colorado), W. E. Shanks, and Robert R. Smith. 1965. A METHOD FOR COLLECTING METABOLIC EXCRETIONS FROM FISH. The Progressive Fish-Culturist, Vol. 27, No. 2, pp. 108-111.

The best features of previous designs have been incorporated in a chamber used for collection of metabolic excretions. (G. Post)

7677. Reichelt, Herbert W., Jr., and Carroll A. Joyner (U. S. Bureau of Sport Fisheries and Wildlife, Millen, Georgia). 1965. USE OF GELATIN AS A FOOD-BONDING AGENT. The Progressive Fish-Culturist, Vol. 27, No. 2, p. 66.

Procedure for preparing gelatin liver mixture.

7678. Schaefer, Richard H. (New York Conservation Dept., Oakdale, New York). 1965. A SYSTEM TO GET RUNNING SEA WATER FROM OCEAN SURF. The Progressive Fish-Culturist, Vol. 27, No. 2, p. 74.

A wellpoint, pump, and hose are used to provide a constant flow of sea water to striped bass (Roccus saxatilis) in a tank on the beach above the high-water mark. (Auth.)

7679. Gammon, James R. (Depaux University, Greencastle, Indiana). 1965. DEVICE FOR COLLECTING EGGS OF MUSKELLUNGE, NORTHERN PIKE, AND OTHER SCATTER-SPAWNING SPECIES. The Progressive Fish-Culturist, Vol. 27, No. 2, p. 78.

A screened wood tray that can be planted in spawning areas. (Auth.)

7680. Shelton, J. M. (U. S. Bureau of Commercial Fisheries, Portland, Oregon). 1965. PLASTIC BAG TRANSPORT OF SALMON AND STEELHEAD BY AIR AND CAR. The Progressive Fish-Culturist, Vol. 27, No. 2, p. 86.

7681. Conroy, David A. (Universidades Nacionales de Buenos Aires, Mar del Plata, Argentina). 1965. RESEARCH ON BACTERIAL FISH DISEASES IN THE INSTITUTE OF MARINE BIOLOGY (ARGENTINA). The Progressive Fish-Culturist, Vol. 27, No. 2, p. 100.

7682. Anonymous. 1965. FISH-DISEASE TREATMENTS AND THE U. S. FOOD AND DRUG ADMINISTRATION. The Progressive Fish-Culturist, Vol. 27, No. 2, p. 107.

7683. Wolf, Ken (U. S. Bureau of Sport Fisheries and Wildlife, Kearneysville, West Virginia). 1965. INFECTIOUS PANCREATIC NECROSIS: ITS DETECTION AND IDENTIFICATION. The Progressive Fish-Culturist, Vol. 27, No. 2, p. 112.

Ultimate control of IPN virus requires under-

standing of the difference between viral detection and viral identification techniques. (Auth.)

7684. Okuno, Ryonosuke (Suma Aquarium Kobe City, Kobe, Japan). 1963. INTRA- AND INTER-SPECIFIC RELATIONS OF SALT-WATER FISHES IN AQUARIUM. II. FISHES BELONGING TO ORDER PERCIDA AND OTHERS. Japan Jour. Ecol. 13(2): 46-53. (In Japanese with English summ.) Biological Abstracts, Vol. 45, No. 14, Abst. No. 58427. 1964.

Intra- and interspecific relations of 43 species of salt-water fishes were studied by their chasing behavior in tanks of the Suma Aquarium. By comparing the frequency of intraspecific chasing with that of interspecific chasing for each species, 15 species, Kuhlia taeniura, Diploprion bifasciatus, Girella punctata, G. melanichthys, Lethrinus haematopterus, L. choerorhynchus, Gymnocranius griseus, Haplochromis nitens, Therapon jarbua, T. oxyrhynchus, Abudefduf sordidus, Microcanthus strigatus, Prionurus microlepidotus, Siganus fuscescens, and Stephanolepis cirrhifer, are recognized as the intraspecific chasing type. Eight other species, Epinephelus fasciatus, Lethrinus nematocanthus, Amphiprion xanthurus, A. frenatus, A. chrysogaster, Tetradrachmum trimaculatum, Tridentiger trigonocephalus, and Abudefduf vaigiensis, are regarded as the nonspecific chasing type. When these chasing types were compared with social behavior in the open sea, it was found that intraspecific chasing type correlates with the schooling behavior in the natural habitat and the nonspecific chasing type correlates with the assemblage and solitary behaviors. (Auth.)

7685. Amanov, A. A., and F. A. Turdakov. 1962. THE AMU-DAR'YA TROUT IN THE BASIN OF THE SURKHANDAR'YA RIVER. (AMU-DAR'INSKAYA FOREL' V BASSEINE R. SURKHANDAR'I.) Uzbeksk Biol. Zhur. 5. 73-79; (Uzbek summ.) Referat. Zhur., Biol., 1963, No. 15164. (Translation) Biological Abstracts, Vol. 45, No. 14, Abst. No. 58485. 1964.

A study was made of body dimensions (150 specimens), fecundity (33 specimens), food (60 specimens), and growth rate (100 specimens) of the Amu-Dar'ya trout of 134-219 mm length. Sexual dimorphism was observed in the part situated between the snout and the ventral fin, as well as along the maxilla and the postorbital part of the head. Fecundity ranged from 255 to 527 eggs. Growth rate was found to be similar to that of the Varzob River trout, and higher than that of the Armenian trout.

7686. Anisimova, I. M. 1963. CHARACTERISTICS OF THE OFFSPRING OF CRUCIAN CARP MATED WITH MALE CARP, GOLDFISH, AND TENCH. (KACHESTVO POTOMSTVA SEREBRY-ANOGO KARASYA PRI AKRESHCHIVANII S SAMT-SAMI KARPA, ZOLOTOTO KARASYA I LINYA.) Dokl. Mosk. Sel'skokhoz. Akad. im k a Timiryazeva 85. 342-349; Referat. Zhur., Biol., 1963,

No. 20158. (Translation) Biological Abstracts, Vol. 45, No. 14, Abst. No. 58486. 1964.

Hybrid offspring obtained by crossing goldfish (Carassius auratus) females with carp (Cyprinus carpio) males, as well as with crucian carp (Carassius carassius) and tench (Tinca tinca) males, were similar in morphological indices and diet. They differed, however, in spawning capacity, growth rate, and structure of their gonads. The most successful cross was goldfish X crucian carp; no spawning occurred with tench in the majority of cases, and what spawn was produced perished. Highest mortality of spawn was observed for the group silver crucian carp X tench; the lowest, in the group silver crucian carp X crucian carp. Most rapid growth rate was observed for the goldfish X carp hybrid.

7687. Bauer, O. N. 1962. A NEW METHOD OF MANAGING CARP LAKES IN EAST GERMANY. (NOVYI METOD VEDENIYA KARPOVOGO OZERNOGO KHOZYAISTVA V GDR.) Nauchn.-Tekh. Byul. Gos Nauchn.-Issled. Inst. Ozerного i Rechnogo Rybn. Khoz. 16. 42-46; Referat. Zhur., Biol., 1963, No. 20189. (Translation) Biological Abstracts, Vol. 45, No. 14, Abst. No. 58490. 1964.

An experiment in raising yearling carp in East German lakes is described. The lakes range in area from 10 to 40 ha, and are about 2 m deep. Stocking density is 300-500 specimens per ha, at an average rate of 250-300 g of stocking material per ha. Supplementary food consists of corn grains, as well as of cakes of barley, lupine, soybean, and others. For obtaining the commercial weight of 1 kg, the fish are fed about 1 metric ton of food per ha per summer. The fertilizer is phosphate, given at the rate of 30 kg of pure phosphoric acid per ha and introduced in a single lot in May. Before the autumn fishing, the lake level is lowered by removing some water by means of pumps.

7688. Borovik, E. A., and S. V. Kokhnenko. 1962. EEL DROPSY IN FRESH WATERS. (K VOPROSU O KRASNUKHE UGREI V PRESNYKH VODAKH.) In: Gidrobiologicheskie issledovaniya. (Hydrobiological research.) Tartu. 3. 287-291; (Estonian and German summ.) Referat. Zhur., Biol., 1963, No. 15112. (Translation) Biological Abstracts, Vol. 45, No. 14, Abst. No. 58493. 1964.

A description is given of clinical signs and pathological-anatomical changes produced by eel dropsy in fish obtained from carp ponds. Consideration is given to the question concerning the agent of infection. It is assumed that the separate form Pseudomonas punctata f. sacroviensis, which causes dropsy in eels, evolved from P. punctata f. ascitae which causes infectious dropsy (red-spot disease) in carp.

7689. Burmakin, E. V. 1962. ON THE USE OF SMALL LAKES FOR FISH PRODUCTION. (O RYBOKHOZYAISTVENNOM OSVOENII MALYKH OZER.) In: Gidrobiologicheskie issledovaniya. (Hydrobiological research.) Tartu. 3. 344-352; (Estonian

and German summ.) Referat. Zhur., Biol., 1963, No. 15195. (Translation) Biological Abstracts, Vol. 45, No. 14, Abst. No. 58494. 1964.

Improvement in the fish-fauna composition of small lakes is largely dependent upon the extermination of the natural fish population. Lakes cleared of low-value fish and subsequently treated with fertilizers can be used as fish nurseries or fattening ponds. Experiments were conducted in Lake Zhemchuzhnoe and in the eastern part of Lake Tyulen'e, which were treated with polychlorpinene at a concentration of 0.15 mg/l. This concentration caused the death of Acerina cernua, Perca fluviatilis, and Esox lucius. A concentration of polychlorpinene higher than 0.25 mg/l caused the death not only of fishes but also of zooplankton and many forms of zoobenthos.

7690. Chepurnova, L. V. 1962. THE EFFECT OF THE REGULATION OF THE FLOW OF THE DNIESTER RIVER ON THE OOGENESIS AND SPAWNING OF VIMBA VIMBA. (VLIYANIE ZAREGULIROVANIYA DNESTRA NA OVOGENEZ I NEREST RYBTSA (VIMBA VIMBA VIMBA NATIO CARINATA (PALL.)) Uch. Zap. Kishinevsk Univ. 62(1): 141-149; Referat. Zhur., Biol., 1963, No. 15160. (Translation) Biological Abstracts, Vol. 45, No. 14, Abst. No. 58496. 1964.

As a result of the construction of the Dubossari Hydroelectric Power Plant, the spawning of V. vimba downstream from it was seriously disrupted. In autumn the development of oocytes proceeds normally and reaches completion when the eggs of the first batch attain their largest size. Toward the maturation period of the oocytes, which in Vimba usually occurs between March and the first half of May, there was heavy atresia in the first egg batch of some females, and in the second batch of others (V. vimba spawns twice in one season). None of the females captured at the dam between the end of April and mid-July showed any significant traces of previous spawning. The disruption of the spawning of V. vimba is explained by the fact that V. vimba, being a coastal fish, was unable to find favorable spawning conditions near the dam. For increasing the abundance of V. vimba, the author recommends creation of artificial spawning grounds in the region downstream of the dam.

7691. Kokhmenko, L. V. 1962. FEEDING INTERRELATIONSHIPS BETWEEN YOUNG AUTUMN CHUM SALMON AND FRESH-WATER SALMONIDS IN THE RESERVOIRS OF THE TEPLOV FISH FARM. (PISHCHEVYE SVYAZI MAL'KOV OSENNEI KETY I PRESNOVODNYKH LOSOSEVYKH V VYRASTNYKH VODOEMAKH TEPLOVSKOGO RYBOVODNOGO ZAVODA.) Izvest. Tikhookeansk. Nauchn.-Issled. Inst. Rybn. Khoz. i Okeanog. 48: 67-84; Referat. Zhur., Biol., 1963, No. 15155. (Translation) Biological Abstracts, Vol. 45, No. 14, Abst. No. 58505. 1964.

A study was made of the nutrition of 787 specimens of grayling (Thymallus thymallus, lenok (Brachymystax lenok), and taimen (Hucho taimen)

caught in Lake Teploe, the Bira River, and the Teplov side channel in April-July and autumn of 1951-54. In the Bira River young grayling feed on mayfly larvae (38.6%), chironomid larvae and pupae (17%), and stonefly larvae (18%). In spring young grayling of Lake Teploe feed mainly on Asellus and chironomids; young chum salmon (Onchorynchus keta), which occupy first place by weight in the food of young grayling (45.7%), have a frequency of occurrence of 4.8% in their stomachs. Chironomids are the basic food of young grayling in the summer. In the Teplov side channel young grayling feed on chironomids, and also on mayflies in the summer. Caddis flies predominate in the food of grayling in the Bira River, where, in April, the young of spring chum have a subsidiary significance as food. In autumn, there are many chum eggs in grayling stomachs. Young lenok eat benthos and juvenile fish, especially the young of spring chums, which occupy first place in the food of lenok young in Lake Teploe in the summer. Taimen young consume benthos and young chum; adult taimen consume fish--small predators, as well as Amur ide (Leuciscus waleckii), minnows (Phoxinus phoxinus) and other fishes which compete with young chums for food. Comparison of the food spectrum of young spring chums with those of other fishes studied showed the greatest nutritional similarity between chum and grayling, with respect to chironomid larvae (Syndiamesa nivosus), Asellus, and larvae of the caddis fly Apatania zonella. However, the present population size of grayling does not cause serious competition with the chums. The young of lenok and of taimen also occur in small numbers and, hence, they do not seriously affect the food supply of chums.

7692. Mamontova, L. N. 1962. FERTILIZATION OF PONDS WITH AMMONIUM SULFATE. (UDOBRENIE PRUDOV SUL'FATOM AMMONIYA.) Dokl. Mosk. Selskokhoz. Akad. im ka a Timiryazeva 78. 359-362; Referat. Zhur., Biol., 1963, No. 151107. (Translation) Biological Abstracts, Vol. 45, No. 14, Abst. No. 58509. 1964.

Laboratory experiments have shown that ammonium sulfate introduced at N levels of 1, 3, 5, and 7 mg per liter of water had no ill effects on fry and fingerlings of carp. Ammonium sulfate at N level of 2 mg/l, and superphosphate at a P level of 0.2 mg/l were introduced into a growing pond 4 ha in area. The first portions of fertilizer were introduced 10 days prior to stocking. Initially the ponds were fertilized daily, and then every 3 days. By October fish production amounted to 834 kg/ha.

7693. Moen, Tom (Iowa Cons. Comm., Spirit Lake). 1964. FEEDING YOUNG FLATHEAD CATFISH. Progressive Fish-Culturist 26(1): 26; Biological Abstracts, Vol. 45, No. 14, Abst. No. 58511. 1964.

7694. Privol'nev, T. I., and V. I. Efimov. 1962. DECHLORINATION OF THE WATER SUPPLY IN

THE KANDALAKSHA FISH HATCHERY. (DEKHLORIROVANIE VODOPROVODNOI VODY NA KANDALAKSHSKOM RYBOZAVODE.) Nauchn.-Tekh. Byul. Gos. Nauchn.-Issled. Inst. Ozerogo i Rechnogo Rybn. Khoz. 16. 57-60; Referat. Zhur., Biol., 1963, No. 20198. (Translation) Biological Abstracts, Vol. 45, No. 14, Abst. No. 58519. 1964.

The proposed method for water dechlorination by spraying into the air with an atomizer (a diagram is given) simultaneously ensures 100% saturation of the water with O₂ and its warming up by 3-4° C. Water treated in this manner facilitated quicker development of spawn, larvae, and young of Salmonidae.

7695. Tabb, Durbin (Inst. Mar. Sci., Miami, Florida). 1961. A CONTRIBUTION TO THE BIOLOGY OF THE SPOTTED SEATROUT, Cynoscion nebulosus (Cuvier) OF EAST-CENTRAL FLORIDA. Florida State Bd. Cons. Tech. Ser. 35. 1-24. Illus. Map; Biological Abstracts, Vol. 45, No. 14, Abst. No. 58532. 1964.

Studies were conducted in the Indian River area from 1955 to 1957. This species grows rapidly. Average growth rates of 16, 8, 7, 6, and 6 cm for the first 5 years were obtained by the scale calculation method. Growth seems to be faster in the study area than in other areas. Females grow faster and live longer than males. Few males live longer than 6 years. The maximum age observed was 10 years and the maximum weight 13 lb 10 oz. The species is carnivorous, rapacious and feeds sporadically. Pink and brown shrimps, mysids, and small fishes are the bulk of its diet. Egg production ranged from 15,000 for 15-inch fish to 1,100,000 for 28-inch fish. Spawning occurs in deeper holes and channels and from mid-April to late July. Adults exhibit local movements and concentration during the spawning season when they are intensively fished. (Auth.)

7696. Wolf, Ken (E. Fish Dis. Lab., Kearneysville, West Virginia), M. C. Quimby, and Arthur D. Bradford. 1963. EGG-ASSOCIATED TRANSMISSION OF IPN VIRUS OF TROUTS. Virology 21(3): 317-321. Illus.; Biological Abstracts, Vol. 45, No. 14, Abst. No. 58542. 1964.

IPN virus of salmonid fishes has been isolated and identified in suspect but normal-appearing stocks of adult brook trout (Salvelinus fontinalis), and, thus, a pattern for the epizootiology of the virus has been demonstrated. Virus titers as high as 10^{6.5} ID₅₀ were found in egg fluids from 7 of 12 fish tested. In contrast, egg homogenates contained much less virus; their maximum titer was 10^{1.8} ID₅₀. The presence of virus within the eggs, however, was not established. Viral neutralizing ability of serum from the same fish showed an inverse relationship to the presence of virus in "ovarian fluid." The highest serum titers occurred in those fish from which little or no virus had been isolated. (Authors)

7697. Yur'ev, G. S. 1962. ECOLOGICAL FORMS OF WILD CARP IN PROLETARSK RESERVOIR (MANYCH). (OB EKOLOGICHESKIKH FORMAKH SAZANA V PROLETARSKOM VODOKHRANILISHCHE (MANYCH).) Tr. Stavropol'sk Sel'skokhoz. Inst. 11. 64-68; Referat. Zhur., Biol., 1963, No. 15126. (Translation) Biological Abstracts, Vol. 45, No. 14, Abst. No. 58544. 1964.

There are 3 ecological forms: (1) yellow, growing well, in the food-rich eastern part (attains a weight of 1000 g in 3 years); (2) yellow, growing poorly, in the western part (attaining a weight of 700 g in 3 years); (3) black, growing slowly and inhabiting bulrush thickets (500 g in 3 years). The fish differ markedly in a number of morphological characters. All these forms came into being in the course of 7 to 8 years.

7698. Zelenin, A. M., and A. I. Naberezhnyi. 1962. ON REARING GRASS CARP (CTENOPHARYNGDON IDELLA VAL.) AND SILVER CARP (HYPOPHthalmichthys molitrix VAL.) IN MOLDAVIA. (K VOPROSU VYRASHCHIVANIYA BELOGO AMURA (CTENOPHARYNGDON IDELLA VAL.) I TOLSTOLOBIKA (HYPOPHthalmichthys molitrix VAL.) V MOLDAVII.) In: Biologicheskie resursy vodoemov Moldavii. (Biological resources of Moldavian waters.) Shtiintsa: Kishinev. 68-75; Referat. Zhur., Biol., No. 151100. (Translation) Biological Abstracts, Vol. 45, No. 14, Abst. No. 58545. 1964.

Young silver carp and grass carp (30,000 specimens each) were raised in Moldavian ponds at an initial density of 24,000 specimens per hectare. The hydrochemical regime and the food base of the ponds were investigated. Growth rate in the first cultivation period varied significantly according to the condition of the food base. The highest growth rate was observed in grass carp from mid-July to mid-August, and to mid-September in silver carp. A study of their feeding showed that 49 species, of which 23 were algae, were common to both; their basic food, however, was different. Transition to feeding on zooplankton was obligate. On the whole, the food supply of grass carp and silver carp was satisfactory, and the growth rate rapid.

7699. Kusakina, A. A. 1959. CYTOPHYSIOLOGICAL INVESTIGATION OF MUSCULAR TISSUE DURING CROSS-BRED VIGOR OF SOME INTERSPECIFIC FISH HYBRIDS. (TSITOFIZIOLOGICHESKOE ISSLEDOVANIE MYSHECHNOI TKANI PRI GETEROZISE U NEKOTORYKH MEZHVIDOVYKH GIBRIDOV RYB.) Tsitologiya 1(1): 111-119; Referat. Zhur., Biol., 1960, No. 28624. (Translation) Biological Abstracts, Vol. 45, No. 14, Abst. No. 59684. 1964.

Investigations were made of the speed of the development of lack of muscular excitability which sets in under the influence of high temperatures (24-34° C) and of ethyl alcohol in ripus (Coregonus albus ladogensis), and in ludoga whitefish (Coregonus lavaretus ludoga) and their reciprocal hybrids, as well as in salmon, taimen (Hucho taimen Pall.)

and their hybrids. The hybrids are more able to endure high temperatures and the effect of alcohol than their parent forms. In order to establish the role of proteins in the heat resistance of the cell, tests were made on the resistance to the cholinesterase and changes in the sorptive properties of the muscles due to high temperatures. Heat resistance to cholinesterase is higher in hybrids; intensified sorption of the basic and acidic vital stains by "heated" muscles is lower than that of control muscles in the parent forms. This points to the fact that a process of change of the cell proteins takes place in the hybrids, conditioning unspecific increase of cell resistance. It appears that cross-bred vigor can also be observed on the cellular plan. (Courtesy NSF (PL 83-480) 1963.)

7700. Ali, M. A. (Univ. Montreal, Montreal, Quebec, Canada). 1964. STRETCHING OF RETINA DURING GROWTH OF SALMON (SALMO SALAR). Growth 28(1): 83-89. Illus.; Biological Abstracts, Vol. 45, No. 14, Abst. No. 59755. 1964.

This paper describes the results of an investigation undertaken in order to test a hypothesis, viz. whether the retina stretched during the growth of the salmon. The numbers of ganglion cells and cones per unit length of an 8 μ section were counted in one section from each of the eyes of fish ranging in age from eyed embryos, just prior to hatching, to two-year-old fish. It appears from the data that, as the fish gets longer and its eye gets larger, the number of ganglion cells and cones per unit length decreases. This decrease may be attributed to the retina getting stretched due to its rate of growth (increase in its thickness or formation of retinal elements) being slower than the rate of growth of the eyeball. The reduction in the number of cones per unit area is smaller than that of the ganglion cells because the cones are formed through a much longer period during the life history of the fish. Fish from Quebec appear to differ from those from Nova Scotia with regard to the number of cones per unit area at different stages. However, the reduction in the number of their cones follows a trend similar to that of the Nova Scotia fish. (Auth.)

7701. Tavalga, William N. (City Coll. New York, New York, N. Y.). 1964. PSYCHOPHYSICS AND HEARING IN FISH. Nat. Hist. 73(3): 34-41. Illus.; Biological Abstracts, Vol. 45, No. 14, Abst. No. 59807.

This review leads to the conclusion that fish can respond to subsonic vibrations of the water, and to sonic vibrations up to at least 2,000 cps with some able to perceive up to 8,000 cps. The most sensitive range is below 800 cps. The swimbladder is the main sound receiver, transmitting its vibrations to the inner ear, but the lateral line system is also a hearing organ. (Auth.)

7702. Floch, Hervé, Robert Deschiens, and Yannick Le Corroller (Inst. Pasteur, Paris, France). 1963. THE MOLLUSCICIDAL PROPERTIES OF

CHEVREUL'S COPPER SULFITE SALT IN THE PROPHYLAXIS OF SCHISTOSOMOSIS. (SUR LES PROPRIETES MOLLUSCICIDES DU SEL CUPRO-SULFITIQUE DE CHEVREUL EN PROPHYLAXIE DES BILHARZIOSES.) Bull. Soc. Pathol. Exot. 56(2): 182-189. (English summ.) Biological Abstracts, Vol. 45, No. 14, Abst. No. 61154. 1964.

Chevreul's copper sulfite is a selective molluscicide recommended for use in rivers and fish ponds for the control of snail vectors of schistosomosis. It kills all *Australorbis glabratus* and *Bulinus contortus* snails in 3 days or less after 24 hours exposure to 1 ppm and in 5 days after exposure to 0.25 ppm. It kills all eggs of the snail *Lymnaea stagnalis* in 2 days at 10 ppm but not in 1 day at 20 ppm. It kills all goldfish, sticklebacks, and guppies in 1 day at 90 ppm; toad and frog tadpoles in 1 day at 15 ppm, 2 days at 10 ppm, or 3 days at 5 ppm; libellulid larvae in 1 day at 40 ppm or 3 days at 20 ppm; *Daphnia longispina* in 1 day at 2 ppm; the aquatic plant *Lemna media* in 10 days at 10 ppm; and green algae in 10 days at 20 ppm and retards their growth at 10 ppm. Its residual activity lasts more than a year at 1 ppm at room temperature. (N. D. L.)

7703. Blackburn, Robert D., and Lyle W. Weldon (Crops Research Div., Agricultural Research Service, U. S. Dept. Agriculture, Ft. Lauderdale, Florida). 1964. CONTROL OF SOUTHERN NAIAD IN FLORIDA DRAINAGE AND IRRIGATION CHANNELS. Weeds, Vol. 12, No. 4, pp. 295-298.

The most promising of 13 herbicides for the control of southern naiad (*Najas guadalupensis* (Spreng.) Magnus) were acrylaldehyde (acrolein), mono-N, N-dimethylcocoamine and di-N, N-dimethylcocoamine salts of 7-oxabicyclo(2.2.1)heptane-2, 3-dicarboxylic acid (endothal), 6,7-dihydropyrido (1,2-a:2',1'-c) pyrazidiinium salt (diquat), and 1,1-dimethyl-4,4'-bipyridinium salt (paraquat). Acrolein and the 2 alkylamine salts of endothal gave the most rapid kill of southern naiad but retreatment was necessary at the end of 16 weeks. Diquat and paraquat were the 2 most promising materials evaluated. Large scale applications of acrolein, di-N, N-dimethylcocoamine salt of endothal and diquat confirmed these results. Diquat and paraquat were the only herbicides of the 13 that were not toxic to fish. (Authors)

7704. Larson, Omer R. (Dept. of Biology, Univ. N. Dakota, Grand Forks). 1965. DIPLOSTOMULUM (TREMATODA: STRIGEOIDEA) ASSOCIATED WITH HERNIATIONS OF BULLHEAD LENSES. The Journal of Parasitology, Vol. 51, No. 2, pp. 224-229.

Autopsies on 144 bullheads (*Ictalurus melas* and *I. nebulosus*) from North Dakota and Minnesota revealed a high incidence of diplostomulum-infected lenses. The majority of these lenses possessed dorsally situated cysts. The incidence and intensity of infection varied from one collection area to another, but the cysts typically housed more flukes than the lenses. Anatomical and histological comparisons between normal and parasitized eyes indi-

cate that the cyst results from a herniation of the lens near the point of attachment of the dorsal ligament. The pressure required for this protrusion appears to come from the parasites, the hyperplastic lens epithelium, and the reactivity of the lens substance to the parasites. Cyst production, its effects, and its relationship to host age and worm burdens are discussed. (Auth. Abst.)

7705. Calentine, Robert L. (Wisconsin State Univ., River Falls). 1965. THE BIOLOGY AND TAXONOMY OF BIACETABULUM (CESTODA: CARYOPHYLLAEIDAE). The Journal of Parasitology, Vol. 51, No. 2, pp. 243-248.

Adults of the caryophyllaeid cestodes *Biacetabulum infrequens* Hunter and *B. macrocephalum* McCrae occur in catostomid fishes and proceroids develop in annelids of the genus *Tubifex*, but not in those of *Limnodrilus*. Proceroids are characterized by a cercomer, primordia of gonads, and a well-developed scolex. *B. macrocephalum* proceroids are infective to fish at 62 days. The genus *Archigetes* is distinguished from *Biacetabulum* on the basis of differences in morphology, definitive hosts, intermediate hosts, and larval development. (Auth. Abst.)

7706. Hunn, J. B., and P. O. Fromm (Dept. of Physiology and Pharmacology, Michigan State Univ., East Lansing). 1964. UPTAKE, TURNOVER AND EXCRETION OF I-131 BY RAINBOW TROUT (*SALMO GAIRDNERI*). The Biological Bulletin, Vol. 126, No. 2, pp. 282-290.

NaSCN inhibits I-131 uptake by the lower jaw (thyroid) and increases the rate of loss of I-131 from trout, presumably by way of the gills. The biological half-life ($T_{1/2}$) of ionic I-131 in the blood plasma of trout is 1.7 days. I-131 is excreted in the urine and by the gills, with the urinary loss being 3.8 times that of the gill per unit time. The I-131 urine/plasma ratios indicate that the trout kidney absorbs much of the filtered iodide. (Authors)

7707. Musacchia, X. J., S. S. Neff, and D. D. Westhoff (Dept. of Biology, St. Louis Univ., St. Louis 4, Missouri). 1964. ACTIVE TRANSPORT OF D-GLUCOSE BY INTESTINAL SEGMENTS, IN VITRO, OF *ICTALURUS NEBULOSUS*. The Biological Bulletin, Vol. 126, No. 2, pp. 291-301.

Active transport of D-glucose was shown in intestinal sac in vitro preparations made from the bullhead catfish, *Ictalurus nebulosus*. D-xylose and D-fructose did not undergo active transport. Population and/or seasonal differences in absorption characteristics were evident in studies from year to year. Low temperatures, 0-2° C, or phlorizin, 5×10^{-4} M, inhibit the absorption of D-glucose. Nitrogen (100%) anaerobiosis was inhibitory to D-glucose, 10 mg/100 ml, active transport in less than half of the intestinal segments tested, and with 5 mg/100 ml there was no inhibition of active transport. In an extension of tissues which can be credited with exhibiting active

transport, catfish intestine may now be cited in comparative physiology. (Authors)

7708. Minckley, W. L. (Dept. Zoology, Arizona State Univ., Tempe). 1963. THE ECOLOGY OF A SPRING STREAM, DOE RUN, MEADE COUNTY, KENTUCKY. Wildlife Monographs, No. 11, 124 pp.

Chemical, physical, and biological features of the stream were studied and are reported. Five stations were established along the 9.7-mile course of the stream. Water temperatures at the upstream Station I were between 13.0° and 13.5° C in periods of modal flow, but increased to between 13.5° and 14.5° after high discharges in spring of 1961. The maximum recorded stream temperature was 25.6° C at Station V, but surface temperature in mill impoundments often reached 30°. Invertebrates present in the stream are listed and special ecological relations of certain abundant species are given in detail. Sixty-six species of fishes were collected and data on the distribution, abundance, reproduction, and movements are annotated. The author presents arguments for the existence of climates in flowing waters analogous to those found in terrestrial situations.

Fishes, because of their plasticity of ontogenetic instantaneous response to their environment in streams, apparently are superimposed on the other systems and are not an integral part of any given assemblages of plants or invertebrates.

7709. Zimmer, Paul D., and John H. Broughton (U. S. Bureau of Commercial Fisheries Program Office, Portland, Oregon). 1965. ANNUAL FISH PASSAGE REPORT - ROCK ISLAND DAM, COLUMBIA RIVER, WASHINGTON, 1963. U. S. Fish and Wildlife Service Special Scientific Report--Fisheries No. 500, 23 pp.

Fish utilizing the three fishways at Rock Island Dam in 1963 were counted from May 1 to October 30. The 106,554 salmon and steelhead trout counted exceeded the 1962 count by about 34,800 fish.

The count of 34,688 chinook salmon recorded in 1963 was well above the mean of 16,777 for the 30-year period 1933-62 and exceeded the 1962 count by only 534 fish. The count of 64,768 sockeye salmon exceeded the 30-year mean of 51,164 and was about 35,500 more than recorded in 1962. The coho salmon count of 20 in 1963 was about 25 percent of the 30-year mean of 83 and 3 percent of the record count of 737 in 1962. The steelhead trout count of 7,078 in 1963 was more than twice the 30-year mean of 3,336 and about 500 less than the number recorded in 1962. Fish other than salmon and steelhead trout passing through the fishways at Rock Island Dam in 1963 numbered 137,367, as compared to 164,574 in 1962, and exceeded the 1963 count of salmon and steelhead trout by about 30,800 fish.

Of the 106,554 salmon and steelhead trout passing Rock Island Dam in 1963, about 2 percent had evidence of injury about the head or body. (Authors)

7710. French, Robert R., and Roy J. Wahle (U. S. Bureau of Commercial Fisheries Biol. Lab., Seattle, Washington). 1965. SALMON ESCAPEMENTS ABOVE ROCK ISLAND DAM, 1954-60. U. S. Fish and Wildlife Service, Special Scientific Report--Fisheries No. 493, 18 pp.

This paper summarizes (1) 7 years' data, 1954-60, on the size and timing of salmon and steelhead runs passing Rocky Reach damsite on the Columbia River above Rock Island Dam and (2) the distribution and abundance of salmon in tributary spawning streams. The majority of spring chinook salmon passing Rock Island continue past Rocky Reach and the Wells damsite to spawn in the Methow River system. Most summer chinook salmon spawn in the Wenatchee River. Sockeye salmon spawn primarily in the Okanogan River in Canada and in the White River in the Wenatchee River system. Length frequency measurements of spawned chinook salmon show that main size groups of probably many age groups are usually present in all tributaries each year. Few unspawned female chinook salmon were observed on the spawning grounds; egg retention was remarkably low among spawned chinook salmon. (Authors)

7711. Coots, Millard (4674 Lookout Dr., Redding, California). 1965. OCCURRENCES OF THE LOST RIVER SUCKER, DELTISTES LUXATUS (COPE), AND SHORTNOSE SUCKER, CHASMISTES BREVIROSTRIS COPE, IN NORTHERN CALIFORNIA. Calif. Fish and Game, Vol. 51, No. 2, pp. 68-73.

The Lost River sucker and the shortnose sucker are added to the fresh-water fish fauna of California. Their distribution, a brief discussion of habits, and meristic data are included. (Auth.)

7712. Swift, Camm. 1965. EARLY DEVELOPMENT OF THE HITCH, LAVINIA EXILICAUDA, OF CLEAR LAKE, CALIFORNIA. Calif. Fish and Game, Vol. 51, No. 2, pp. 74-80.

In 1962 and 1963, eggs were collected from hitch during their spawning in tributaries of Clear Lake. The eggs were hatched using improved hatchery apparatus. Observations of the stages of development of both eggs and larvae are described and shown in drawings up to the juvenile stage. (Auth.)

7713. Turner, Charles H., Earl E. Ebert, and Robert R. Given. 1965. SURVEY OF THE MARINE ENVIRONMENT OFFSHORE OF SAN ELIJO LAGOON, SAN DIEGO COUNTY. Calif. Fish and Game, Vol. 51, No. 2, pp. 81-112.

During March and April 1964 California Department of Fish and Game biologist-divers made an ecological investigation of the marine environment offshore of San Elijo Lagoon, San Diego County. This study, conducted for the State Water Quality Control Board, provided estimates of the numbers and diversity of marine life in this area, prior to inception of a community

waste discharge through a submarine outfall.

Observations were made along three transects, run perpendicular to the shore, from the intertidal out to depths of 80 feet. Sampling, conducted at 20-foot depth intervals along these lines included: (i) core samples in sand bottom areas, (ii) water temperatures, (iii) visibility estimates, (iv) general bottom description, (v) enumeration (estimates) of plants and animals, (vi) quantitative sampling (by actual removal) of growths of the rocky outcrops within a one-fourth meter square, and (viii) photographs.

The area is composed of two general bottom types: flat sand and rocky shelf. A total of 239 kinds of plants and animals were recorded during the survey; only 16 were from the sand areas. These biological assemblages are potentially threatened by the outfall discharge.

Additional diving surveys are recommended after the outfall begins operation. These post-outfall and pre-outfall data may then be compared to evaluate the adequacy of the existing water quality criteria. (Authors)

7714. Hubbs, Clark (Dept. Zoology, Univ. Texas, Austin). 1965. DEVELOPMENT TEMPERATURE TOLERANCE AND RATES OF FOUR SOUTHERN CALIFORNIA FISHES, FUNDULUS PARVIPINNIS, ATHERINOPS AFFINIS, LEURESTHES TENUIS, AND HYPSOBLENNIUS SP. Calif. Fish and Game, Vol. 51, No. 2, pp. 113-122.

Eggs of four fishes, California killifish, Fundulus parvipinnis Girard; topsmelt, Atherinops affinis (Ayres); California grunion, Leuresthes tenuis (Ayres); and mussel blenny, Hypsoblennius sp., were incubated at a variety of temperatures. Larvae hatched at temperatures between 16.6 and 28.5, 12.8(-) and 26.8, 14.8 and 26.8, and 12.0(-) and 26.8(+)° C, respectively. The minimum temperature for successful incubation can be correlated with breeding season. California killifish eggs hatch more slowly in total darkness, while light seems to kill California grunion eggs. (Auth.)

7715. Lanse, Roger. 1965. THE OCCURRENCE OF WARMOUTH, CHAENOBYTTUS GULOSUS (CUVIER), IN THE LOWER COLORADO RIVER. Calif. Fish and Game, Vol. 51, No. 2, p. 123.

Method and date of capture, total and fork length, weight, and age are presented for the six officially identified warmouths taken since 1961. (Auth.)

7716. Briggs, John C. (Inst. of Marine Science, Port Aransas, Texas). 1965. THE CLINGFISHES (GOBIESOCIDAE) OF GUADALUPE ISLAND, MEXICO. Calif. Fish and Game, Vol. 51, No. 2, pp. 123-125.

The examination of unidentified clingfish material from the Scripps Institution of Oceanography collection has helped to clarify our knowledge of the geographical relationship of the Guadalupe Island marine fauna. The island clingfish fauna may now be said to consist of three species, but only one

(Rimicola sila) can still be classed as an endemic.

Since only four or five fish species can still be considered well-defined endemics and the autochthonous mollusks make up a relatively small part of their group, Guadalupe Island must be considered an integral part of the California Warm-temperate Zoogeographic Region. The incidence of endemism seems proportionate to the degree of spatial isolation. (Auth.)

7717. Phillips, J. B. 1965. RANGE EXTENSION FOR THE BIGMOUTH SOLE, HIPPOGLOSSINA STOMATA. Calif. Fish and Game, Vol. 51, No. 2, pp. 125-126.

The northern range of this marine fish is extended into Monterey Bay, California, maximum recorded fish length is increased to 14 inches, and a depth record of 100 fathoms is noted. (Auth.)

7718. Beardsley, Alan J., and Howard F. Horton (H. F. H., 319 Ext. Hall, Oregon State Univ., Corvallis, Oregon). 1965. AN AMBICOLORED STARRY FLOUNDER FROM YAQUINA BAY, OREGON. Calif. Fish and Game, Vol. 51, No. 2, pp. 126-128.

An ambicolored starry flounder from Yaquina Bay, Oregon, was brownish-black on the blind side, except for the anterior one-third of the head and the leading edge of the pectoral fin, which was white. Other anomalies were the dark lips, symmetrical mouth, incompletely-rotated left eye, anteriorly-hooked dorsal fin, and numerous spinous stellate plates on the blind side. The literature is reviewed and two previously reported anomalous starry flounders are described. Possible causes of ambicoloration are listed. (Authors)

7719. Benson, Norman G., and Ross V. Bulkley (Rocky Mountain Sport Fishery Investigations, Logan, Utah). 1963. EQUILIBRIUM YIELD AND MANAGEMENT OF CUTTHROAT TROUT IN YELLOWSTONE LAKE. U. S. Fish and Wildlife Service, Bur. Sport Fish. & Wildl., Research Report 62, 44 pp.

Equilibrium yield of the cutthroat trout, Salmo clarki lewisi Girard, in Yellowstone Lake, Wyo., is determined from data on catch and spawning runs from 1945 to 1961. Changes in growth rate, spawning runs, mortality rates, and year-class strength are related to differences in total catch. Three stages of exploitation of the stock are defined, and the maximum safe catch or equilibrium yield is estimated at 325,000 trout. Management of the sport fishery according to equilibrium yield is discussed with reference to regulations, distribution of fishing pressure, planting, and interspecific competition. The Yellowstone River fishery is treated briefly. (Authors)

7720. Burrows, Roger E. (Salmon-Cultural Lab., Bureau of Sport Fisheries and Wildlife, Longview, Washington). 1964. EFFECTS OF ACCUMULATED EXCRETORY PRODUCTS ON HATCHERY-REARED SALMONIDS. U. S. Fish and Wildlife

Service, Bur. Sport Fish. & Wildl., Research Report 66, 12 pp.

In experiments at the Bureau's Salmon-Cultural Laboratory, to determine the excretory products of significance in rearing ponds and the possible effect of these products on fingerling chinook salmon (*Oncorhynchus tshawytscha*), the results demonstrate that ammonia and urea are the principal products. The relative amounts of these products vary with the concentration of fish and with their metabolic activity. Ammonia assumes dominance in an unfavorable environment. The pH, water temperature, and pond type affect the toxicity of ammonia solutions. Continuous exposure to levels of ammonia normally encountered in rearing ponds produced extensive hyperplasia of the gill epithelium in controlled experiments. In rearing ponds, prolonged but not continuous exposure in unionized ammonia has been demonstrated to result in reduction both in growth rates and in physical stamina. It is postulated that the gill hyperplasia resulting from continuous exposure to un-ionized ammonia is a precursor of bacterial gill disease. (Auth. Abst.)

7721. Warren, Charles E. (Dept. of Fisheries and Wildlife, Oregon State Univ., Corvallis), Joseph H. Wales, Gerald E. Davis, and Peter Doudoroff. 1964. TROUT PRODUCTION IN AN EXPERIMENTAL STREAM ENRICHED WITH SUCROSE. The Journal of Wildlife Management, Vol. 28, No. 4, pp. 617-660.

From 1960 through 1963, three experiments were performed on the production, food habits, and food consumption of coastal cutthroat trout (*Salmo clarki clarki*) in sucrose-enriched and in unenriched sections of Berry Creek, a small woodland stream in the Willamette River Basin of Oregon. These experiments were part of a general investigation of the trophic pathways through which energy from light, organic debris, and dissolved organic matter enters into the production of fish and other organisms. The flow in a 1,500-foot portion of Berry Creek was controlled by means of a diversion dam and a bypass canal. Four sections of this portion of the stream, each consisting of a riffle and a pool, were separated by fine screens which prevented the drifting of fish-food organisms from one section to the next. The water in two sections was continuously enriched by introducing a few milligrams of sucrose per liter, and most of the deciduous forest canopy was removed from one of the enriched and one of the unenriched sections. Only the enrichment with sucrose led to large and consistent increases in food consumption and production of trout: food consumption was increased about twofold and trout production usually much more than sevenfold. Trout production increased so much more than food consumption because only a relatively small portion of the comparatively large amount of food consumed in the enriched sections was required for maintenance of the trout stocks. The maintenance food requirements of the trout in the four sections usually were not materially different, but most of the food produced and available in the

unenriched sections was required for maintenance, with little left for promoting growth. Food consumption values are believed to be more reliable measures of the relative productivity of the different sections for trout than are production values. Results of studies of food habits of the trout and available data on biomasses of insects in the riffles indicate that increased food consumption and production of trout in the enriched sections were made possible by greater abundance of aquatic food organisms, especially of tendipedid (chironomid) larvae, the consumption of terrestrial food being roughly equal in all sections. Introduction of sucrose resulted in growth of the bacterium *Sphaerotilus natans*, a slime organism frequently associated with organic pollution. This bacterial growth provided food and habitat for tendipedid larvae, the most important food organisms of trout in the enriched sections. Concepts of trophic relations in aquatic ecosystems and the application of these concepts to problems of water resource management are discussed in the light of the findings. (Authors)

7722. Brown, William G. (Dept. of Agricultural Economics, Oregon State Univ., Corvallis), Ajmer Singh, and Emery N. Castle. 1964. NET ECONOMIC VALUE OF THE OREGON SALMON-STEELHEAD SPORT FISHERY. Journal of Wildlife Management, Vol. 29, No. 2, pp. 266-279. 1965.

Gross and net economic values of the Oregon salmon-steelhead sport fishery were estimated from angler expenditure data obtained by main survey during 1962. Salmon-steelhead includes primarily chinook salmon (*Oncorhynchus tshawytscha*), silver salmon (*Oncorhynchus kisutch*), and steelhead trout (*Salmo gairdneri*). Net economic value was defined as the estimated annual value of the sport fishery resource to a single owner if a market existed for the opportunity of fishing for salmon and steelhead. Net economic value was measured from demand functions. These demand functions were based on the Clawson method but were generalized to take account of income and distance traveled by the anglers. Net economic value was estimated to be about \$3 million in 1962. If income and population trends of the past 10 years in Oregon continue, a 50 percent increase in net economic value by 1972 is predicted. The methods employed appear promising for estimating economic benefits from wildlife resources. (Authors)

7723. De Roth, Gerardus C. (The Defiance Coll., Defiance, Ohio). 1963. AGE AND GROWTH STUDIES OF CHANNEL CATFISH IN WESTERN LAKE ERIE. The Journal of Wildlife Management, Vol. 29, No. 2, pp. 280-286. 1965.

Left pectoral spines were collected from 1,478 channel catfish (*Ictalurus punctatus*) taken in western Lake Erie during 1957, 1958, and 1959. Projected images of thin cross sections of the spines were utilized for age assessment and growth calculations. Spine radius measurements were found to correlate very closely with total lengths ($r = 0.996$)

in a linear relationship. Calculated average total lengths in inches corresponding to each annulus were I--2.5, II--6.5, III--8.9, IV--10.6, V--11.7, VI--13.0, VII--14.3. At least 50 percent of the Lake Erie catfish are mature by the time they reach total lengths ranging from 10 to 12 inches. Data suggest that females mature at a somewhat smaller size than do males. Fifty percent or more of both sexes are mature by the end of their fifth year of life. No difference is evident between the length-weight relationships of the two sexes, nor does there appear to be any significant difference between the rate of length increase in the two sexes until the age of maturity is reached. After the fourth year of life, growth rates seem to decrease, with the male rate declining less than that of the female. Catfish from Lake Erie appear to be heavier per inch of total length than fish from either Oklahoma or the upper Mississippi River, but fish from the latter two areas seem to exhibit a somewhat greater annual weight increment after the second year of growth. (Auth. Abst.)

7724. Kirchen, R. V. (Dept. Zool., Univ. Rhode Island, Kingston). 1963. RADIOPATHOLOGY AND DOSIMETRY IN THE THYROID REGION OF GOITROUS KILLIFISH FED I¹³¹ UNDER EURYHALINE CONDITIONS. In: Proceedings of the Hanford Symposium on the biology of radioiodine, Richland, Wash., 1963. Hlth. Phys. 9(12): 1341. 1963. Biological Abstracts, Vol. 45, No. 15, Abst. No. 63002. 1964. Abstract only.

7725. Workman, Gar William. 1964. AN ECOLOGICAL STUDY OF THE BEAR LAKE LITTORAL ZONE, UTAH-IDAHO. Dissert. Absts. 24(7): 3034-3035; Biological Abstracts, Vol. 45, No. 15, Abst. No. 63119. 1964. Abstract only.

7726. Ancieta, Felipe (Min. Agric., Lima, Peru). 1962. THE BONITO FISHERIES IN PERU. (LA PESQUERIA DEL BONITO EN EL PERU.) In: Proceedings of the World Scientific Meeting on the Biology of tunas and related species, La Jolla, California, 1962. FAO Fish. Repts. 3(6): 1607-1619. Illus. 1963. (English and French summ.) Biological Abstracts, Vol. 45, No. 15, Abst. No. 63122. 1964.

Describes fishing methods, fishing grounds and seasons, and analyzes the biological factors which regulate the availability of *Sarda chiliensis* in Peruvian waters. Total and areal production are described as well as the catch composition. (Auth.)

7727. Andrushaitis, G. P. 1963. ACCLIMATIZATION OF FISHES IN THE INLAND WATERS OF THE LATVIAN SSR. (AKKLIMATIZATSIYA RYB VO VNUTRENNIK VODOEMAKH LATVIJSKOI SSR.) In: Akklimatizatsia zhivotnykh v SSR. (Acclimatization of animals in the USSR.) Akad. Nauk Kazhsk. SSR: Alma-Ata. 212-213; Referat. Zhur., Biol., 1963, No. 201107. (Translation) Biological Abstracts, Vol. 45, No. 15, Abst. No. 63123. 1964.

The paper considers the favorable results, as well as the prospects, of acclimatizing in Latvian ponds and lakes Lake Chir whitefish (*Coregonus lavaretus maraenoides*), peled (*C. peled*), eastern carp (*Cyprinus carpio haematopterus*), goldfish (*Carassius auratus*), zander (*Stizostedion luciperca*) and rainbow trout (*Salmo gairdneri*). Despite its good growth, the Baikal omul (*Coregonus autumnalis migratorius*), cannot be acclimatized in Latvia due to the lack of suitable spawning grounds.

7728. Anpilova, V. I. 1963. BIOLOGICAL BASIS AND PROSPECTS FOR THE ACCLIMATIZATION OF SPRING-SPAWNING WHITEFISH IN THE MORE IMPORTANT RESERVOIRS OF THE USSR. (BIOLOGICHESKOE OBOSNOVANIE I PERSPEKTIVY AKKLIMATIZATSII VESENNERESTUYUSHCHEGO SIGA V VAZHNEISHIKH VODOKHRANILISHCHAKH SSR.) In: Akklimatizatsia zhivotnykh v SSSR. (Acclimatization of animals in the USSR.) Akad. Nauk Kazhsk. SSR: Alma-Ata. 214-216; Referat. Zhur., Biol., 1963, No. 201109. (Translation) Biological Abstracts, Vol. 45, No. 15, Abst. No. 63125. 1964.

Early spring spawning of the Bauntov whitefish can be ensured by its acclimatization in reservoirs, where its spawn can be incubated under spring flood conditions. Because of their temperature conditions and the absence of competition for food, the Kuibishev and Gor'kii reservoirs are suitable for the acclimatization of whitefishes.

7729. Azbelev, V. V., and S. S. Surkov. 1963. EXPERIMENTAL ACCLIMATIZATION OF PINK AND CHUM SALMON IN THE BASIN OF THE BARENTS AND WHITE SEAS. (OPYT AKKLIMATIZATSII GORBUSHI I KETY V BASSEINE BARENTSOVA I BELOGO MOREI.) In: Akklimatizatsia zhivotnykh v SSSR. (Acclimatization of animals in the USSR.) Akad. Nauk Kazhsk. SSR: Alma-Ata. 210-211; Referat. Zhur., Biol., 1963, No. 201106. (Translation) Biological Abstracts, Vol. 45, No. 15, Abst. No. 63126. 1964.

The introduction of eggs of chum (*Oncorhynchus keta*) and pink salmon (*O. gorbuscha*) into the basin of the Barents and White Seas was begun in 1957. In the period 1960-62 migrations to the rivers of the Kola Peninsula and to other northern regions were observed. Pink salmon forage apparently in the Norwegian Sea. Survival rate of young varied from year to year and was conditioned by the periodic appearance of predators (young of cod and herring) in the pre-estuarine zone. Survival rate of spawn of local pink salmon was conditioned by natural spawning, and that of pink salmon in fish hatcheries by the temperature. Owing to the large fluctuations in the survival rate of pink salmon, its spawn should, for the time being, be imported from the Far East.

7730. Blackburn, Maurice (Univ. of California, Scripps Inst. Oceanog., La Jolla). 1962. DISTRIBUTION AND ABUNDANCE OF TUNA RELATED TO WIND AND OCEAN CONDITIONS IN THE GULF

OF TEHUANTEPEC, MEXICO. In: Proceedings of the World Scientific Meeting on the Biology of tunas and related species, La Jolla, Calif., 1962. FAO Fish. Repts. 3(6): 1557-1582. Illus. Maps. 1963. (French and Spanish summ.) Biological Abstracts, Vol. 45, No. 15, Abst. No. 63127. 1964.

The Gulf of Tehuantepec is exposed to northerly winds which blow consistently in winter. They cause a circulation which results in an undulating pycnocline topography; they also stir the upper part of the pycnocline in the area of its greatest elevation, where eutrophication results. It was hypothesized that yellowfin are more abundant in this area and season than in any other in the Gulf, by reason of their aggregation upon the expected high concentrations of their prey. This hypothesis was tested by analysis of variance of logged means of yellowfin catch/day by baitboat, classified by areas, years, and seasons. It was not confirmed in its original form, but it was confirmed when the assumption of an average lag of 3 months between wind action and resulting crop of small nekton (yellowfin food) was made; i. e., the expected differences between areas occur in spring instead of winter. No differences were found between years, despite much variability in surface temperature over the period studied; average in 1953, low in 1954 to 1956, and high in 1957 to 1959. The same pattern of yellowfin distribution could, therefore, be expected from year to year in the spring months. A similar analysis of contemporaneous skipjack data gave an entirely different result: only differences between years were significant, with catch per day highest in cool years and very low in warm years. (Auth.)

7731. Chermisina, V. T., and G. M. Stepanova. 1962. SOME FACTORS AFFECTING O₂ UPTAKE RATE IN FINGERLING CARP IN MOLDAVIAN REARING PONDS. (NEKOTORYE POKAZATELI INTENSIVNOSTI POTREBNIYA KISLORODA SEGOLETKAMI KARPA V VYROSTNYKH PRUDAKH MOLDAVII.) In: Biologicheskie resursy vodoemov Moldavii. (Biological resources of Moldavian bodies of water.) Shtiintsa: Kishinev. 76-82; Referat. Zhur., Biol., 1963, No. 20171. (Translation) Biological Abstracts, Vol. 45, No. 15, Abst. No. 63131. 1964.

The O₂ uptake rate was determined in closed containers. In natural conditions, diurnal rhythm of O₂ uptake rate was found to occur as a consequence of sharp fluctuations in both the dissolved O₂ content (from 3-7 mg/l during the morning to 20-21 mg/l during the day) and water temperature. Leveling of temperature and O₂ regimes in ponds was followed by leveling of the metabolic rate of fish. The quantity of O₂ used up by fish during the growing period in ponds is conditioned by the composition of fertilizers applied to the ponds. Highest O₂ utilization was observed in ponds treated with plant fertilizers; in ponds fertilized with compost extracts and manure the O₂ utilization rate was low. Respiration rate was found to depend on stocking density also, falling as the stocking density rose.

A direct relationship between growth rate and respiration rate was observed only when the O₂ content was high.

7732. Chikova, V. M. 1963. REPRODUCTION OF THE PRINCIPAL COMMERCIAL FISHES IN THE CHEREMSHAN INLET OF KUIBYSHEV RESERVOIR IN 1960 AND 1961. (RAZMNOZHENIE OSNOVNYKH PROMYSLOVYKH RYB V CHEREMSHANSKOM ZALIVE KUIBYSHEVSKOGO VODOKHRANILISHCHA V 1960 I 1961 GG.) In: Materialy po biologii i gidrologii volzhskikh vodochrnilishch. (Materials on the biology and hydrology of Volga Reservoirs.) Akad. Nauk SSSR: Moscow-Leningrad. 95-98; Referat. Zhur., Biol., 1963, No. 20154. (Translation) Biological Abstracts, Vol. 45, No. 15, Abst. No. 63132. 1964.

The work was carried out in May-June 1960-61. Spawning grounds were identified by the location of the spawn substrate and the capture of the brood stock in the 5th stage of development. Data are presented on spawning conditions of pike, bream, blue bream, zander, and Volga pike-perch. The water level in 1960 was high until May 20. During the height of the spawning process, the water level fell sharply, laying bare almost the whole shore zone. Until May 20, 1961, the water level was fairly low, but thereafter it steadily rose and remained high until the end of June. As a result, large areas of meadow and brushwood vegetation were flooded, creating favorable conditions for the spawning of lithophilic fish. The main commercial fishes spawn in the littoral zones of the upper part of the inlet and on the flood-plains situated on the inlet's left bank. Reproduction conditions and effectiveness of spawning are conditioned by the water-level regime of the reservoir.

7733. Clemens, Harold B. (Resources Agency Calif., Dept. Fish and Game, Terminal Island). 1962. A MODEL OF ALBACORE MIGRATION IN THE NORTH PACIFIC OCEAN. In: Proceedings of the World Scientific Meeting on the Biology of tunas and related species, La Jolla, Calif., 1962. FAO Fish. Repts. 3(6): 1537-1548. Map. 1963. (French and Spanish summ.) Biological Abstracts, Vol. 45, No. 15, Abst. No. 63133. 1964.

Data concerning Pacific albacore, *Thunnus germon*, migration, age and growth rates together with detailed fishing, catch and oceanographic information have vastly increased our knowledge of albacore life history, biology, and ecology. As a result, a working hypothesis or model of albacore migration in the North Pacific Ocean has been constructed and is presented as a convenient method of summarizing current information and thinking and as a basis from which to advance albacore researches. Transpacific migrations of albacore between the western and eastern sectors of the ocean and various combinations of journeys within and between the current systems dominating each section are described. In addition, the extensive journeys of each age group, both near the surface and at depths, are set forth in some

detail. Finally, a few examples illustrate possible ways of using the model to guide research planning and to improve our understanding of albacore so they can be more fully and efficiently utilized. A major objective is to focus attention on areas where additional studies are needed. This prototype migration model will be revised and improved at every opportunity and the increased knowledge will be made available to all who are interested. (Auth.)

7734. Clemens, Harold B., and Robert A. Iselin (Resources Agency Calif., Dept. Fish and Game, Terminal Island). 1962. **FOOD OF PACIFIC ALBACORE IN THE CALIFORNIA FISHERY (1955-1961).** In: Proceedings of the World Scientific Meeting on the Biology of tunas and related species, La Jolla, California, 1962. FAO Fish. Repts. 3(6): 1523-1535. Map. 1963. (French and Spanish summ.) Biological Abstracts, Vol. 45, No. 15, Abst. No. 63134. 1964.

Pacific albacore are not evenly distributed throughout their preferred sea-temperature range of 60° to 70° (16° to 21° C); instead, they occur in concentrations that are constantly changing throughout the season. Fluctuations in the location, abundance, and availability of food organisms play important roles in regulating albacore movements and distribution. Food items have been identified from albacore stomachs collected by fishermen and Department personnel from July 1955 to September 1961. These data indicate that albacore utilize the wide assortment of edible-sized marine organisms encountered during their travels. The most numerous items eaten were the ones thought to be most available. Potential albacore feeding areas may be determinable by charting the offshore fishing grounds with respect to quantity of suitably-sized marine organisms irrespective of type. (Authors)

7735. Craig, William L. (Resources Agency Calif., Dept. Fish and Game, Terminal Island). 1962. **THE CALIFORNIA ALBACORE FISHERY LOGBOOK SYSTEM.** In: Proceedings of the World Scientific Meeting on the Biology of tunas and related species, La Jolla, California, 1962. FAO Fish. Repts. 3(6): 1217-1225. Maps. 1963. (French and Spanish summ.) Biological Abstracts, Vol. 45, No. 15, Abst. No. 63135. 1964.

A voluntary logbook system combined with legal fish receipts (pink tickets) has been used successfully by the California Department of Fish and Game to obtain catch statistics for the California albacore fishery since 1954. This report describes the design of the logbook and the methods of distributing, collecting, editing, and machine processing the logs. Also, briefly discussed is the potential application of these detailed logbook data to ecological studies as well as to studies of the fishery's dynamics. (Auth.)

7736. Greenwood, Edward C. (Resources Agency Calif., Dept. Fish and Game, Terminal Island). 1962. **CALIFORNIA'S TUNA RECORD GATHERING**

SYSTEM. In: Proceedings of the World Scientific Meeting on the Biology of tunas and related species, La Jolla, California, 1962. FAO Fish. Repts. 3(6): 1367-1379. Illus. Maps. 1963. (French and Spanish summ.) Biological Abstracts, Vol. 45, No. 15, Abst. No. 63142. 1964.

Processing of catch statistics by the State of California is described with emphasis on tuna. Fish receipt usage and inventory methods as well as sale of licenses and registrations are discussed. Water origins, to locate the fisherman's catch, and albacore logs complete the basic source material processed by California. Information on processor records and reports is included along with details on tabulated reports for administrative and research work. (Auth.)

7737. Hamre, Johs (Inst. Norwegian Fish. and Mar. Invest., Bergen, Norway). 1962. **TUNA TAGGING EXPERIMENTS IN NORWEGIAN WATERS.** In: Proceedings of the World Scientific Meeting on the Biology of tunas and related species, La Jolla, California, 1962. FAO Fish. Repts. 3(6): 1125-1132. Illus. 1963. (French and Spanish summ.) Biological Abstracts, Vol. 45, No. 15, Abst. No. 63149. 1964.

During the years 1957-61, 224 bluefin tuna were tagged and released on the Norwegian coast. So far, 22 recoveries have been reported. In one case, the wound caused by the tag was examined and found to be completely healed. The within-season recaptures corroborate a migration pattern found by size frequency analyses of the commercial catches. The change in the migration pattern from the southern to the northern route at about 12 years of age is substantiated by a tag recovery. The between-season recaptures demonstrate a certain exchange of tuna between Spanish and Norwegian waters. Due to subdivision of the stock, it is assumed that long series of data are necessary to elucidate the identity of this tuna population. (Auth.)

7738. Laevastu, Taivo (Univ. Hawaii, Honolulu), and Horacio Rosa, Jr. 1962. **DISTRIBUTION AND RELATIVE ABUNDANCE OF TUNAS IN RELATION TO THEIR ENVIRONMENT.** In: Proceedings of the World Scientific Meeting on the Biology of tunas and related species, La Jolla, California, 1962. FAO Fish. Repts. 3(6): 1835-1851. Illus. Maps. 1963. (French and Spanish summ.) Biological Abstracts, Vol. 45, No. 15, Abst. No. 63157. 1964.

A discussion of world tuna distribution and fishing areas in relation to temperature, depth, currents, transparency of water, food, submarine topography and meteorological factors. Maps of world distribution, fishing grounds and methods are included. (Authors)

7739. Nishimura, Minoru (Fishing Boat Lab., Min. Agric. and Forest., Tokyo, Japan). 1962. **INVESTIGATION OF TUNA BEHAVIOR BY FISH FINDER.** In: Proceedings of the World Scientific

Meeting on the Biology of tunas and related species, La Jolla, California, 1962. FAO Fish. Repts. 3 (6): 1113-1123. Illus. 1963. (French and Spanish summ.) Biological Abstracts, Vol. 45, No. 15, Abst. No. 63168. 1964.

To fish for tunas scientifically, one must know tuna behavior, swimming depth, speed, and school density. Many methods have been used to gather these data, but have not offered sufficient conclusive evidence. In this paper, the author proposes use of a fish finder. After many experiments, it has been established that a fish finder can effectively detect tuna schools and make tuna investigations. First, the author discusses the properties of a fish finder able to detect tunas at a depth of 200 m, and concludes that the instrument must have a sounding depth of more than 3,000 m to operate efficiently. Secondly, data are mentioned on swimming depth, speed, and school density, procured by fish finders in the seas around Japan and in the South Pacific Ocean. These data establish that the swimming depth depends on the degree of illumination of the sky. The relationship between the shape of the banks in the grounds and the distribution of tunas is also explained. Finally, the maximum speed of albacore, yellowfin, and bluefin tuna was observed and appeared to be about 2 or 3 knots under normal conditions; school density was about 0.0001 to 0.0003 fish per cubic meter. (Auth.)

7740. Panov, D. A. 1963. EFFECT OF WATER TEMPERATURE ON FOOD CONSUMPTION OF LARVAL BREEM. (VLIYANIE TEMPERATURY VODY NA POTREBLENIE PISHCHI LICHINKAMI LESHCHA.) In: Materialy po biologii i gidrologii volzhskikh vodochranilishch. (Materials on the biology and hydrology of Volga Reservoirs.) Akad. Nauk SSSR: Moscow-Leningrad. 83-85; Referat. Zhur., Biol., 1963, No. 20176. (Translation) Biological Abstracts, Vol. 45, No. 15, Abst. No. 63169. 1964.

The effect of water temperature on the amount of food consumed by larvae was studied on the Rybinsk Reservoir (1959-1961) by observation and experimentation. In June 1959, at a temperature of 15-16° C, food consumption was 82 mg/l; in 1961, at 11-12°, it was 21 mg/l, and at 8-9° (May 1959), 7.2 mg/l. Laboratory experiments were conducted with bream larvae in stages C₁ and D₂. The larvae were obtained from artificially fertilized eggs. Greatest sensitivity to temperature lowering was manifested by larvae in early stages of development. At a water temperature of 8° C, the food-consumption indices of larvae in the C₁ developmental stage were about 7 times lower than at 20° C; in the D₂ developmental stage the indices were only half as high. Larvae of the same age react to low temperatures differently. Thus, at 8° C only 50% of the larvae continued to take food; the others ceased feeding despite the presence of an abundant supply of food.

7741. Shul'man, G. E. (Azov-Black Sea Res. Inst. Mar. Fish. Management and Oceanog., Kerch,

USSR). 1963. DETERMINATION OF FOOD SUPPLY OF FISH BY THE DEGREE OF FAT ACCUMULATION AND STORAGE IN THE BODY. (OPREDELENIE OBESPECHENNOSTI RYB KORMOM PO INTENSIVNOSTI ZHIRONAKOPLENIYA I UROVNYU ZHIROVYKH ZAPASOV V IKH TELE.) Zool. Zhur. 42(4): 581-588. Illus. (English summ.) Biological Abstracts, Vol. 45, No. 15, Abst. No. 63182. 1964.

According to fat content in the fish body the food supply fluctuates considerably with the year, season, area, and habitat. In this respect, the Sea of Azov considerably exceeds the Black Sea. In order to obtain detailed characteristics of the food supply of Black Sea fish, a study of the dynamics of the fat content in all types of fish is required. (Auth.)

7742. Smirnov, A. I. 1963. SPERM PRODUCTION IN PACIFIC OCEAN SALMON OF THE GENUS ONCORHYNCHUS. (PRODUTSIROVANIE SPERMY TIKHOOKEANSKIMI LOSOSYAMI RODA ONCORHYNCHUS.) Vopr. Ikhtiol. 3(1): 84-98; Biological Abstracts, Vol. 45, No. 15, Abst. No. 63183. 1964.

From 1953 to 1961, on Sakhalin and Kamchatka, the sperm production of Oncorhynchus gorbuscha, O. keta infsp. autumnalis, O. masu, O. nerka, and O. kisutch was studied. The number of sperm per unit volume of ejaculate, per ejaculation, per gram of body weight, and per breeding season were computed. Also computed, the volume of semen per ejaculation and number of fertile ejaculations per breeding season. Productivity varied from year to year and from species to species. The highest and lowest average productivities recorded were 346 and 104 billion sperm per ejaculation in O. kisutch and O. nerka, respectively. O. kisutch also had the largest average semen volume per ejaculation, 19.9 cm³, and per breeding season 192.8 cm³, and the second greatest number of sperm per gram body weight, 115 million (O. masu has 307 million). O. keta produced fertile sperm for the longest duration (26 days), while O. gorbuscha had the shortest sperm-producing period (14 days). The findings verify the observation that salmon males produce several portions of fully fertile sperm over a continuous period during the breeding season, enabling one male to fertilize several females and allowing for a gradual increase of males on the breeding grounds. Males of O. nerka, breeding in quiet waters and found in concentrated numbers on the breeding grounds, as are O. gorbuscha, produce fewer sperm, while males of other salmon studied breeding in swifter waters (up to and exceeding 75 cm/sec) and not so concentrated on the breeding grounds, produce more sperm to insure optimal fertilization. Since fluctuations in sperm production can produce concomitant changes in the salmon numbers of a subsequent generation, its study is necessary to the efficient management of the Pacific Ocean salmon resources. (L. T. P.)

7743. Squire, James L., Jr. (U. S. Fish and

Wildlife Service, Tiburon Mar. Lab., Tiburon, California). 1962. THERMAL RELATIONSHIPS OF TUNA IN THE OCEANIC NORTHWEST ATLANTIC. In: Proceedings of the World Scientific Meeting on the Biology of tunas and related species, La Jolla, California, 1962. FAO Fish. Repts. 3(6): 1639-1657. Illus. Maps. 1963. (French and Spanish summ.) Biological Abstracts, Vol. 45, No. 15, Abst. No. 63185. 1964.

During 1957 to 1960 tuna explorations were conducted in the oceanic northwest Atlantic by the U. S. Fish and Wildlife Service, Bureau of Commercial Fisheries. Bathythermograph casts were made to a minimum of 137 meters at the 111 fishing stations. The area of exploration was centered about the Gulf Stream system, the major hydrographic feature of the oceanic northwest Atlantic. Tuna abundance has been noted in areas of convergence and other current phenomena for the major oceanic circulatory systems. The Gulf Stream is analogous to the Kuroshio Current of the northwest Pacific. The Gulf Stream system has been described in considerable detail, and oceanographic conditions that exist in this area appear to be conducive to the concentration of tuna resources. Similar concentrations of tuna have been described for the Kuroshio Current. Observations were made on water temperature in relation to the occurrence of tuna species: bluefin tuna, Thunnus thynnus; yellowfin tuna, Thunnus albacares; albacore, Thunnus alalunga; bigeye tuna, Thunnus obesus; skipjack tuna, Euthynnus pelamis. Ranges and calculated means were determined for the observed water temperature, both at the surface and at an estimated fishing depth of 52.7 m. Mean water temperatures at the estimated fishing depth were determined for the major species to be: bluefin tuna - 15.5° C, albacore - 17.5° C, yellowfin tuna - 22.2° C. Observed water-temperature ranges indicate bluefin tuna to have the greatest range and yellowfin the least. Observations for oceanic northwest Atlantic tuna were compared to those of Dr. Uda's for the northwest Pacific, and certain similarities for bluefin tuna and yellowfin tuna were noted. (Auth.)

7744. Waldron, Kenneth D., and Joseph E. King (U. S. Bur. Comm. Fish., Biol. Lab., Honolulu, Hawaii). 1962. FOOD OF SKIPJACK IN THE CENTRAL PACIFIC. In: Proceedings of the World Scientific Meeting on the Biology of tunas and related species, La Jolla, California, 1962. FAO Fish. Repts. 3(6): 1431-1457. Illus. 1963. (French and Spanish summ.) Biological Abstracts, Vol. 45, No. 15, Abst. No. 63193. 1964.

An examination of the stomach contents of 707 skipjack from waters near the Hawaiian, Line, and Phoenix Islands showed that by volume the food consisted of 3.7% crustaceans, 19.9% molluscs, 74.6% fish, and 1.8% unidentifiable remains. It was found that skipjack consumed more fish and fewer molluscs than did yellowfin and bigeye tuna. Larval and juvenile tuna, mostly skipjack, constituted a high percentage of the food of skipjack.

Smaller volumes of stomach contents were found for: (1) troll as compared with pole-and-line caught skipjack, (2) subsurface as compared with surface caught skipjack, and (3) small as compared with large skipjack. Variation in the detailed composition, but not in the major food groups, was associated with: (1) size of skipjack, (2) distance from land, (3) time of capture, and (4) month of capture. Variation in the proportion of the major food groups utilized was associated with area of capture. (Authors)

7745. Faktorovich, K. A. 1959. FAT METABOLISM IN ATLANTIC SALMON (SALMO SALAR) IN CONNECTION WITH THE BIOLOGY OF ITS REPRODUCTION (BASED ON DATA OF HISTOLOGICAL ANALYSIS OF LIVER). (ZHIROVOI OB-MEN SEMGI V SVYAZI S OSOBNOSTYAMI BIOLOGII RAZMNOZHENIYA (PO DANNYM GISTOLOGICHESKOGO ANALIZA PECHENI).) Izvest. Vses. Nauchn.-Issled. Inst. Ozerogo i Rechnogo Rybn. Khoz. 48: 94-100; Referat. Zhur., Biol., 1960, No. 76583. (Translation) Biological Abstracts, Vol. 45, No. 15, Abst. No. 63610. 1964.

Fat metabolism is slow in non-active "winter" salmon, wintering in bottom troughs in the lower reaches of rivers, and rapid in the "summer" salmon wintering in the sea with continuing activity. By spawning time fat disappears from the liver of all groups of Salmo salar. In the liver of S. salar, prior to spawning, during spawning, and during downstream migration, a substance is found which stains like fat but is insoluble in organic solvents. It undergoes absorption after a prolonged period of highly nutritive feeding. (Courtesy NSF (PL 83-480) 1963.)

7746. Woodall, A. N. (U. S. Fish and Wildlife Serv., Cook, Washington), and Gilles LaRoche. 1964. NUTRITION OF SALMONOID FISHES. XI. IODIDE REQUIREMENTS OF CHINOOK SALMON. Jour. Nutr. 82(4): 475-482. Illus.; Biological Abstracts, Vol. 45, No. 15, Abst. No. 63694. 1964.

Duplicate groups of 500 chinook salmon (Oncorhynchus tshawytscha) fingerlings raised in water containing 0.2 µg I/liter, were fed a low I basal ration with added NaI to give 0.1, 0.6, 1.1, 5.1, and 10.1 µg I/g dry diet for 24 weeks. A 100-fish sub-lot of each group was fed the diets for an additional 9 months. No significant difference in growth was observed in either feeding period. At the end of the 24-week feeding period the fish fed 0.1 µg I had stored significantly less than had the fish in the remaining groups. Under the experimental conditions reported, the I requirement of chinook salmon fingerlings was 0.6 µg I/g dry diet; for advanced parr the requirement increased to 1.1 µg. (Authors)

7747. Krayukhin, B. V. 1958. THE REGULATORY MECHANISM OF SECRETION OF DIGESTIVE JUICES IN FISHES. (K VOPROSU O MEKHANIZME REGULYATSII OTDELENIYA

PISHCHEVARITEL'NYKH SOKOV U RYB.) Tr. Soveshch. Ikhtiol. Komis. Akad. Nauk. SSSR 8. 179-185; Referat. Zhur., Biol., 1959, No. 35105. (Translation) Biological Abstracts, Vol. 45, No. 15, Abst. No. 63810. 1964.

In the fish the digestion of larger objects is more intensive than that of smaller ones. This is explained as being due to the effect of the mechanical stimulation of the mucous membrane on the stomach secretion. The secretion also depends on the chemical composition of the food introduced through the fistula; it increases during feeding. The secretion of the digestive juices in fasting fish was manifest; this was associated with the self-digestion of the tissue protein of the alimentary canal. The fistular method proved the conditioned reflex secretion of stomach juices which had previously been considered nonexistent in fish. (Courtesy NSF (PL 83-480) 1963.)

7748. Sharratt, Brenda M., I. Chester Jones, and D. Bellamy (Dept. Zool., Univ. Sheffield, Sheffield, England). 1964. WATER AND ELECTROLYTE COMPOSITION OF THE BODY AND RENAL FUNCTION OF THE EEL (ANGUILLA ANGUILLA L.). Comp. Biochem. and Physiol. 11(1): 9-18. Illus.; Biological Abstracts, Vol. 45, No. 15, Abst. No. 64190. 1964.

The water, sodium, potassium, and chloride contents of serum and muscle of yellow and silver eels (Anguilla anguilla L.) in fresh water and sea water are given, together with urine output and glomerular filtration rates. (Authors)

7749. Clark, Nancy B. (Dept. Zool., Univ. Wash., Seattle), and Warren R. Fleming. 1963. THE EFFECT OF MAMMALIAN PARATHYROID HORMONE ON BONE HISTOLOGY AND SERUM CALCIUM LEVELS IN FUNDULUS KANSAE. Gen. and Comp. Endocrinol. 3(5): 461-467. Illus.; Biological Abstracts, Vol. 45, No. 15, Abst. No. 64293. 1964.

Mammalian parathyroid hormone (PTH), estrogen, or both hormones were injected into the plains killifish, Fundulus kansae, and held in either deionized water, Ca^{++} -enriched tap water, or Ca^{++} -free saline in order to determine the effects of such treatment on serum calcium levels and on bone histology. The injection of large doses of PTH into gravid females held in Ca^{++} -free saline caused a drop in serum total calcium levels, but no changes in the structural aspects of bone were observed. Injection of estrogen into gravid females held in Ca^{++} -free saline elevated the total serum calcium levels approximately 60% but had no observable effect upon bone histology or the amount of calcium present in bone as measured by the Von Kossa technique. The total serum calcium levels of the fish injected with both estrogen and PTH did not differ from the controls. It is suggested that bone, in F. kansae at least, is relatively insensitive to mammalian parathormone and estrogens and that the changes in serum calcium observed after treatment with these hormones depend, for the most

part, on the supply of exogenous calcium available to the animals. (Auth.)

7750. Comfort, A. (Dept. Zool., Univ. Cool., London, England). 1963. EFFECT OF DELAYED AND RESUMED GROWTH ON THE LONGEVITY OF A FISH (LEBISTES RETICULATUS, PETERS) IN CAPTIVITY. Gerontologia (Basel) 8(2/3): 150-155. Illus. (German and French summ.) Biological Abstracts, Vol. 45, No. 15, Abst. No. 64978. 1964.

The life-span of the fish Lebistes reticulatus is increased by dietary retardation for 600 days followed by refeeding. Checked and realimented females showed a mean gain in expectation of life at birth of nearly 200 days over unchecked. (Auth.)

7751. Reznichenko, P. N. 1959. ROLE OF EMBRYONIC MOVEMENTS IN THE ONTOGENESIS OF THE BREATHING OF TELEOSTEI. (ROL' EMBRIONAL'NYKH DVIZHENII V ONTOGENEZE DYKHANIYA KOSTISTYKH RYB.) Zur. Obshchei Biol. 20(4): 289-298. (English summ.); Referat. Zhur., Biol., 1960, No. 35186. (Translation) Biological Abstracts, Vol. 45, No. 15, Abst. No. 65045. 1964.

Movements of embryos of 13 species of Teleostei (Cypriniformes, Perciformes, Clupeiformes, Esociformes, and Gadiformes) were studied in polythermostatic aquaria with kymographs. Embryonic development of breathing was divided into 7 stages: the immobile egg receiving O_2 by passive diffusion; (in Esox and Salmonidae immediately before morulation) protoplasmatic movements set in the egg, circulating the perivitelline fluid and encouraging gas exchange; (in all species studied immediately after the formation of tail zone) neuro-muscular movements of embryos set in, intensifying the circulation of the perivitelline fluid; blood begins to circulate; a special mechanism develops, conveying O_2 into the embryo and removing products of gas metabolism dissolved in blood plasma; mobility of embryos continues to increase; erythrocytes appear and the transportation of chemically-bound O_2 begins; gills develop but their filaments are not yet covered with opercula and the exchange of perivitelline fluid surrounding the gills (or of water if the embryo has already hatched from its membrane) is assured by the movement of the entire embryo; gill-jaw pumping apparatus forms; the movements of the whole embryo lose their role in breathing and acquire a new, locomotion role. New mechanisms of breathing have an insignificant role when first formed, but when fully developed, their role exceeds in importance that of the preceding mechanism. The duration and the number of stages and characteristics of breathing mechanisms are different in various species in relation to their environment. (Courtesy NSF (PL 83-480) 1963.)

7752. Trifonova, A. N. 1963. CRITICAL PERIODS OF DEVELOPMENT IN MORPHOGENESIS AND THEIR BIOLOGICAL BASIS. (KRITICHESKIE

PERIODY RAZVITIYA MORFOGENEZA I IKH BIOLOGICHESKOE OBOSNOVANIE.) USP Sovrem Biol. 56(3): 381-402. Illus.; Biological Abstracts, Vol. 45, No. 15, Abst. No. 65055. 1964.

This review deals chiefly with critical periods (beginning of gastrulation, embryo formation and closing of the blastopore) in morphogenesis with emphasis placed on studies made on fish and amphibians by the Department of Hydrobiology and Ichthyology, Leningrad University. The purpose of these investigations was to trace biological and morphological characteristics of critical periods in the development of roe. The characteristics studied included growth rate, accelerating effect of temperature on development, respiration, glycolysis, relationship between vital staining and pH changes, and changes in the nucleic acid concentration and in reactive -SH groups in protein. From the data obtained it was concluded that critical periods in morphogenesis are characterized by poor adaptation to changing environmental factors. The authors analyze possible reasons for this phenomenon, consider morphogenetic processes occurring during critical periods, and compare changes occurring in ova during the critical periods to changes occurring in damaged tissue. Bibliography includes 156 references. (M. M. D.)

7753. Sproul, O. J., and D. W. Ryckman (Univ. Maine, Orono). 1963. SIGNIFICANT PHYSIOLOGICAL CHARACTERISTICS OF ORGANIC POLLU-

TANTS. Jour. Water Pollution Control Fed. 35(9): 1136-1145. Illus.; Biological Abstracts, Vol. 45, No. 15, Abst. No. 65731. 1964.

Concentrations of carbon adsorbable, solvent extractable organic matter were determined for various industrial wastes, sanitary sewage, and river water above and below major points of effluent discharge. Odor potential and quality were measured for CCE material in each case, followed by fish bioassay of the extract using rainbow trout. Natural self-purification provided only partial elimination of adverse organoleptic and physiological responses to organic substances introduced by the effluents studied. (I. G.)

7754. Hoffman, Glen L., and Robert E. Putz (U. S. Fish and Wildlife Serv., E. Fish Dis. Lab., Kearneysville, West Virginia). 1964. STUDIES ON GYRODACTYLUS MACROCHIRI N. SP. (TREMATODA: MONOGENEA) FROM LEPOMIS MACROCHIRUS. Proc. Helminthol. Soc. Washington 27 (1): 76-82; Biological Abstracts, Vol. 45, No. 15, Abst. No. 66626. 1964.

Gyrodactylus macrochiri is described from Lepomis macrochirus and L. cyanellus. Early development and reproductive system are discussed. The effect of temperature, light, waste accumulation, and concomitant infection with Ichthyophthirius were studied. Under crowded conditions, G. macrochiri was transferred to unnatural hosts. (Authors)

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